MANUAL OF INTRAGASTRIC TECHNIQUE

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PRACTICAL LESSONS IN THE USE OF APPARATUS FOR THE DIAGNOSIS AND TREATMENT OF DISEASES OF THE STOMACH

BY

GEORGE HERSCHELL, M.D. Lond.

FELLOW OF THE ROYAL MEDICO-CHIRURGICAL SOCIETY

LONDON

HENRY J. GLAISHER

57, WIGMORE STREET, CAVENDISH SQUARE, W.

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PREFACE

The first difficulty experienced by the physician who is desirous of using modern methods in the diagnosis and treatment of affections of the stomach is the selection and arrangement of the necessary apparatus. The next task is to learn how to use them efficiently. This is by no means easy if the services of an experienced teacher be not available, as the instructions given in the various monographs dealing with gastric disorders do not give the minutely detailed directions which can alone replace personal tuition.

The object of this work is to supply the deficiency, and after guiding the student in the selection of his apparatus to give him in plain language such precise directions for their use that he may without difficulty learn to make use of them to the satisfaction of himself and of his patient.

For the sake of completeness a chapter has been devoted to the examination of the stomach contents. As few tests as possible have been given, and those only have been selected which

from their simplicity are suitable for daily clinical use by men working without the convenience of a properly equipped laboratory.

Whilst not attempting to deal at all exhaustively with the subject, it is hoped that the very elementary instruction offered may be found of use to those commencing the study of the affections of the stomach.

GEORGE HERSCHELL.

36, Harley Street, W.

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CHAPTER I

THE STOMACH TUBE AND ITS TECHNIQUE

The stomach tube—Stomach tube gauge—Accessory apparatus—Arrangement of the patient—Passage of the tube—Removal of tube—Disinfection and care of tube—Difficulties—Contra-indications.

Before discussing the different intragastric methods of diagnosis and treatment, it will be well to devote a short chapter to the study of the stomach tube and its technique, as a perfect acquaintance with this is the key to all modern practice. Any one who can pass an ordinary stomach tube with dexterity will find no difficulty in introducing into the stomach the intragastric electrode, the gyromele or any other instrument which he may wish to use. *Per contra*, no one should attempt to treat a patient by any intragastric method whatever, before, by practice upon a healthy subject, he has made himself thoroughly familiar with the manipulations associated with the passage of a tube.

Although the use of the stomach tube is absolutely necessary for the diagnosis and efficient treatment of many gastric affections, it is rather shirked by the practitioner of medicine in this country on account of difficulties, mostly imagi-

nary. I am convinced that one of the chief reasons why we are so far behind some other countries in the scientific study of gastric affections, is to be found in a deeply rooted idea in the minds of medical men that the patient will not submit to intragastric methods of diagnosis or treatment. And acting upon this belief, they often refrain from suggesting any such procedure to the patient, although perfectly certain in their own minds that it is indicated in the case before them. As a matter of fact, it is extremely rare to meet with a patient who will not allow a tube to be passed into the stomach when he has been convinced of the necessity, and when he finds that the process is painless and not nearly so disagreeable as he anticipated. When it is explained that certain definite data are required to make our diagnosis anything but guess-work, and that such data can only be obtained by the use of the tube, the consent of the patient is readily obtained and he will usually allow us to do whatever we think necessary. With a very nervous patient it is always best to make up your mind that more than one sitting may be required before the tube can be passed into the stomach. You may to a great extent allay the fears of such a patient by promising absolutely to withdraw the tube when he makes a preconcerted sign, such as holding up his hand, and asking him to do so at once if he feels that he cannot bear the operation any longer. At the first attempt you may have only introduced the tube a couple of inches. The patient raises his hand and you withdraw the tube. Do nothing more on this occasion, but make another attempt upon the following day. The patient has now

confidence, as he has learnt that the procedure is not so very unpleasant after all, and he finds by experience that you will keep your word and will withdraw the tube when he makes the sign. On the second trial, if you are fortunate, you will complete the operation to your satisfaction. But on this occasion even, if you should be unable to pass the tube right into the stomach, it will be better to desist and have a third sitting rather than to annoy the patient by fruitless attempts. Of course, other things being equal, the ease with which a tube can be passed depends upon the skill and experience of the operator, and when I hear a doctor say, as I sometimes do, that his patients will not allow him to pass tubes upon them, I cannot help unkind thoughts coming into my mind. After the second trial the most nervous patient will be growing accustomed to the feel of the tube, and your difficulties will decrease every time. With an ordinary patient who is not very nervous, you will pass the tube without difficulty on the first attempt.

The Stomach Tube.—It is of the first importance to select a proper tube. Those in general use are of soft red rubber and vary in pattern. Most of the stomach tubes for sale in this country have two great defects. In the first place the eyes, having been apparently made by punching a hole in the rubber, have sharp cutting edges. They will in consequence act as curettes and very probably injure the mucous membrane of the stomach. There is absolutely no excuse for this, as tubes with bevel-edged eyes have been manufactured in America for the last twenty years under the name "velvet eye." The second draw-

back is the fact that English tubes are constructed with two eyes at different levels. It is obvious that when the liquid in the stomach has sunk below the level of the proximal eye the flow from the stomach will cease. In my opinion the best tube on the market is the pattern suggested by Van Valsah and Nisbet.* In this tube, the end beyond the eye being filled up with solid rubber, the instrument is easily washed and kept aseptic. Any one with practical experience of stomach tubes will at once perceive the advantage, remembering how very difficult it is with the ordinary pattern to remove food *débris* from within the tip. In this tube the eyes also have a different arrangement, and the reasons for this are best given in the words of the inventors.

"It should possess one velvet eye opening of the same size as the calibre, and another very small one with similarly depressed or rounded edges. The large and lower opening should be as near the extremity as possible and the calibre of the tube should end with it. The small upper opening, on a level with and opposite the upper border of the large opening, diminishes the chances of the tube becoming obstructed, or tearing away a piece of the mucous membrane by aspiration. With two large holes the risk of obstruction is twice as great . . . and the stomach can be emptied no lower than the higher one."

It is obvious that since in the above tube no outflow from the stomach can take place unless both eyes are covered with fluid, only one eye can be in contact with mucous membrane at a time,

* "The Diseases of the Stomach," by Van Valsah and Nisbet. Rebman, 1899. Pp. 87, 88.

and the other one must be covered with fluid. Consequently it is almost impossible for an injurious degree of suction to be exercised. On the contrary, with the stomach tubes of ordinary pattern it may happen that both eyes may be in contact with the mucous membrane at the same time, and thus, if the tube be suddenly moved whilst suction is going on, the sharp edges of the eyes will cut the stomach wall and perhaps detach a strip of lining membrane.

Such a tube is supplied by Tiemann, of New York, and can be procured in this country from

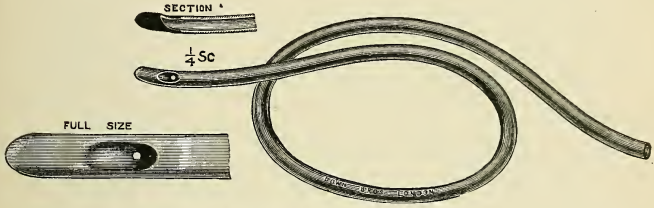

Fig. 1.—Van Valsah's Stomach Tube.

Messrs. Down, of St. Thomas's Street, London, who supply it under the name of the Van Valsah tube.

The size of the tube to be used in any given case will vary with the work which we wish to do with it. For simple inflation of the stomach we shall use a moderately small size. Not the smallest of all, as air might come up alongside of it, but one of about 25 mm. in circumference. For lavage, on the contrary, we should select the largest size which the patient can tolerate, as we thus minimise the possibility of the tube becoming choked with particles of food or with mucus.

The most rational way of numbering stomach tubes is doubtless the system adopted in France for catheters, viz., the number of the instrument denotes its circumference in millimetres. This is more satisfactory than the present system, in which each instrument-maker appears to have his own arbitrary scale. In the present work I shall adopt this plan, and when I allude to the number of a tube, I shall be understood to imply its circumference in millimetres.

It is well to bear in mind, other things being equal, that moderately large stomach tubes are passed with greater facility than small ones. The reason of this lies in the fact that a tube properly passed is virtually grasped and swallowed by the œsophagus, and the larger the tube the better grip it will be enabled to take upon it. Also a large tube will not so readily bend or kink. Of course there is a limit to the size of the tube used, first because beyond a certain point the tube will lose its elasticity, and secondly, because a tube of extra large diameter will obstruct the respiration and cannot be tolerated by the patient. For use in general practice, an outfit of six tubes, respectively 25, 30, 32, 35, 38 and 40 mm. in circumference, and about 80 cm. in length for ordinary cases, and two, 25 and 35 mm. circumference respectively and 95 cm. in length, for use in dilated stomach, will meet all requirements.

As the printed numbers upon stomach tubes soon wear off, the specialist, or physician who treats large numbers of gastric cases, will find advantage in the use of a gauge by which he can ascertain at any time the diameter of any tube he is using. As in the French catheter

scale, the number of the instrument should denote its circumference in millimetres. Such a gauge is sold by Tiemann, of New York, for use with catheters, but as the range extends to No. 40 (40 mm. in circumference), it may obviously be used for stomach tubes as well.

It is as well to have an indicator upon the tubes by which one may know when its tip reaches the cardiac orifice of the stomach. The best and simplest is a small turned ring of vulcanite fitted to each tube. It should be of such a tightness that it will preserve its position and yet not constrict the tube. The use of such a contrivance is far better than marking with paint or ink, as not only will such a mark wash off, but the proper distance varies with each patient. The distance from the teeth to the cardiac orifice of the stomach averages about 40 cm., but it may be found approximately for the individual patient by placing the end of the tube upon the tip of the spinous process of the ninth dorsal vertebra, and bringing the tube up alongside the neck and face to the incisor teeth, and more accurately by McCaskey's cardiameter (*vide* page 74).

I would here draw attention to a little point which is as a rule not alluded to in the text-books, namely, that it is not at all impossible for a stomach tube to be swallowed and to slip bodily into the stomach of the patient. This accident can easily be guarded against by attaching to each of your tubes a foot of stout thread. The best method of doing so is to fasten a small metal ring to the proximal extremity of each of your tubes by means of a strip of sheet indiarubber. This will present no difficulty to any one who is accustomed

to repair punctures in bicycle tyres. A narrow strip of pure sheet rubber is cut long enough to go once and a half round the stomach tube. The end of the tube is well cleaned with benzine, the rubber solution is applied to both it and to the rubber strip. After a few minutes, when the rubber solution has set and become tacky, the strip is threaded through the ring and wound round the stomach tube at the prepared spot. This is now well secured with thread wound round, and put away for a few hours, when adhesion will have occurred and the thread may be removed.

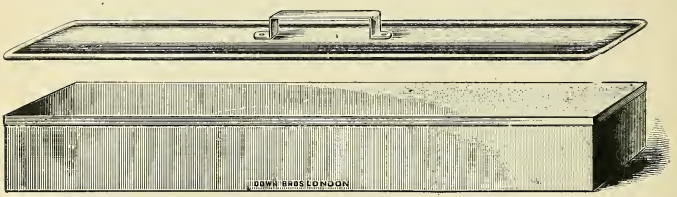

Fig. 2.—Metal Box for Storing Stomach Tubes.

The complete outfit of stomach tubes should be kept well powdered with French chalk in a long, flat metal box, with a well-fitting lid. It is important that this box should be long enough to allow the tubes to lie extended at full length, as they last much longer if kept in this manner.

Having selected your tube, the first point to attend to is the arrangement of the patient and the different accessories. You must provide against the soiling of the patient's clothes by the mucus and saliva which will drop from his mouth; you must provide a receptacle in which any vomited material may be caught in case retching

comes on, and you must have a basin ready to receive the tube when it is withdrawn. The fact of these being ready and in their proper places will make all the difference in practice between a neat and a clumsy operation. The position of the operator with respect to the patient is also of first importance. We will discuss these points seriatim.

The Protection of the Patient's Clothes.—For this purpose Professor Turck, of Chicago, has devised a very ingenious rubber pocket which is fastened by a band around the patient's neck and lies upon his chest, the mouth of the bag being kept open by a wire framework. In ordinary daily practice, I have found the most convenient thing to use is a long bath towel, the two corners of one end of which are fastened behind the neck with a safety pin. The towel, hanging down and over the knees, completely covers the front of the body and forms a perfect protection. If the operation is conducted in an ordinary room, a mackintosh sheet, which may be carried to the patient's house and forms a useful addition to the bag of apparatus, should be placed under the patient's chair. If the patient is in bed the mackintosh sheet should be spread over the bedclothes and the towel aforesaid arranged upon it.

Basins Required.—We shall require two basins: one containing the stomach tube immersed in hot water, and into which it is replaced after it has been withdrawn from the stomach of the patient; and the other in readiness in case the patient should vomit. (Of course these basins are in addition to any special apparatus used in lavage or other mode of treatment, and are required in every case.)

If the patient is lying in bed the two basins are simply placed upon it alongside the patient, and given in charge of an attendant whose duty it is to see that the water does not get spilt upon the bed, and that, if retching occurs, the empty basin is forthcoming in time to catch any ejected material.

In passing a tube at the house of a patient who is able to sit up, the basins are placed upon a small table at his right-hand side.

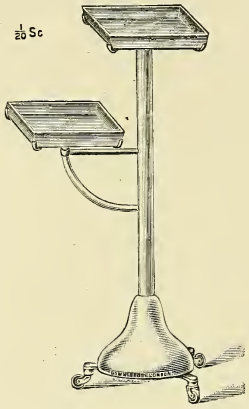

Fig. 3.—The Mackintosh Stand.

In one's consulting room, it is a great convenience to make use of a little stand on castors holding two porcelain trays. This has been designed by Dr. Mackintosh, of Glasgow, and is shown in the accompanying illustration. It can be wheeled quite up to the patient, and whilst the higher of the two trays contains the hot water and the tube, the lower one is convenient for the

patient to vomit into should he be compelled to do so.

Lubrication of the Tube.—A well-wetted rubber tube will usually pass without any especial lubrication. In some very sensitive throats, however, a lubricant will materially facilitate the passage of the tube, and for this purpose I can strongly recommend glycerine jelly made according to the following formula. It is efficient and not at all unpleasant, and does not injure the indiarubber of which the tube is composed, and it can be easily removed by washing.

GLYCERINE JELLY.

℞

Gelatin	2	drachms.
Aq. Rosæ trip.	6	fluid oz.
Glycerin	6	,,
Ac. Salicyl.	12	grains.
Alcohol Absolut.	1½	drachms.
Albumin. ovi	6	,,

Soak the Gelatin for twelve hours in the Rose Water and dissolve in a steamer. Add the Salicylic Acid (dissolved in the Alcohol) and the Glycerin. Mix, cool, and add the white of egg, steam thoroughly for an hour or two until clarified; finally filter through white paper in the steamer.

It should be put up in collapsible tubes. It is far better so, as by this means we escape any possible contamination and ensure it being quite fresh.* Personally, I most frequently employ the menthol and cocaine pastel mentioned on page 15.

* This glycerine jelly, in collapsible tubes, may be procured from Martindale, 10, New Cavendish Street, W.

The Passage of a Tube.—In passing a tube always stand behind and to the right side of the patient, passing your left arm over his left shoulder and holding the tube in the right hand between the thumb and first two fingers, with the eye of the tube towards your little finger. In this position, if the patient should unfortunately vomit, he will not do so up your sleeve. The patient is now directed to sit quite upright, bend his head a little forwards and open his mouth. The operator now places the tube upon the patient's tongue and pushes it gently backwards. At the moment when the end of the tube is felt to touch the back of the pharynx, the patient is directed to swallow. At the moment when the larynx is seen to ascend, the tube is pushed quickly in and will be grasped by the pharyngeal muscles and carried downwards into the stomach. The operator at this moment transfers the tube to the fingers of the left hand and grasps it with the right a few inches further up and tries to pay it into the mouth at the same rate that it is being carried into the stomach by the action of swallowing. This is all done by practice quickly, yet without hurry or the use of force. Whilst the tube is being passed the patient should continue his efforts to swallow, and as the act of swallowing cannot be performed with the mouth wide open, he should be directed to close his lips upon the tube and really try to suck it down, taking care not to bite it with his teeth. If the patient appears the least distressed, stop for a moment and tell him to breathe slowly and deeply through the nose. As soon as he has recovered or the discomfort has passed off, the tube should be again pushed onwards into the stomach.

The technique of passing the tube should be thoroughly mastered, as all intragastric instruments, such as the electro-diaphane, the gyromele, or the tube of the stomach spray are passed in exactly the same manner.

The Removal of the Tube.—The best way to avoid soiling the clothes of the patient or the carpet by drippings from the tube, is to nip it between the fingers and thumb of the right hand so as to entirely close its lumen, and as you withdraw it gently, approach a basin held in the other hand as near as possible to the patient's face in such a manner as to receive the end as it leaves the mouth. Do not relax your pressure on the tube until it is all in the basin.

The Disinfection and Cleansing of the Tube.—First of all wash it thoroughly in soap and water. Then allow a stream of water to run through it by inserting the end of a tap with a fine nozzle into its open end and turning on the water. Then put it to soak in a 5 per cent. solution of carbolic acid, a 5 per cent. solution of lysol in water, or a 1 in 1,200 solution of chinosol. I prefer chinosol, as the germicidal action is greater than that of corrosive sublimate without the special dangers of the latter. The tube must then be again washed in plain sterile water, and hung up to drain in an airy cupboard well protected from dust. If the tube is in daily use, it may remain in the cupboard until again wanted. If not, it should when dry be well powdered with French chalk and stored away in the metal tray, previously mentioned on page 8. It is needless to say that each patient under constant treatment should be provided with his own special tube, devoted to his case alone, and all

tubes used for cancerous, syphilitic, or tuberculous patients should be destroyed after the treatment of the patient has come to a conclusion.

Difficulties in the Passage of the Tube.—These may arise from :—

1. *Defective technique on the part of the operator.*—The most usual mistake is to allow the patient to throw his head too far back. If this is done the bodies of the cervical vertebræ are thrown forward and the orifice of the gullet narrowed from behind forwards. Sufficient stress is not placed upon this point in the different text-books, and in some, absolutely erroneous directions are given, as the following quotation from one of the most recent monographs will show. For obvious reasons the name of the book is not given.

> ". . . then asking him to throw his head slightly back, the point of the tube is introduced over the tongue into the pharynx."

If these directions were carried out the passage of the tube would be rendered unnecessarily difficult.

Another common error is to allow the most favourable moment to pass before paying the tube into the mouth of the patient. This should be done immediately the act of swallowing is commenced, as in this case the tube will be grasped by the muscles of the pharynx and drawn down towards the stomach. If at this psychological moment its onward passage is assisted by a gentle prolonged push, it will often pass at once right into the stomach.

The third mistake made by novices is to attempt to push the tube in too fast. If this is done, and

the tube happens to be of small size, it will kink and double upon itself, and its progress be arrested. Should this unfortunately happen, the remedy is to withdraw it a few inches, make the patient again perform the act of swallowing, and try again.

Lastly, take care that the patient does not close his teeth upon the tube. In making the act of swallowing he should be directed to suck the tube by closing his lips upon it, but without exerting any pressure upon it either with lips or teeth.

2. *An irritable condition of the pharynx.*—This is often met with in conjunction with chronic gastritis, chronic alcoholism, or as the result of slight degrees of nasal obstruction. It may easily be overcome either by giving the patient a little pledget of cotton wool saturated in a 2 per cent. solution of cocaine to suck, or by the preliminary spraying the fauces with the following solution, as recommended by Hemmeter * :—

℞

Three per cent. solution of cocaine in benzoinol ... ... fl 3 ij.
One per cent. solution of menthol in liquid vaselin oil .. ... fl 3 iv. Misce.

To be used in B. W. & Co.'s atomiser or in a Globe nebuliser.

In my own practice I usually give the patient a glycerine pastel containing menthol $\frac{1}{1\frac{1}{2}}$ and cocaine $\frac{1}{2\frac{1}{0}}$ grain. This, besides exercising a quite appreciable sedative effect upon the throat, as it is made on a glyco-gelatin basis, provides a certain

* Hemmeter, "Diseases of the Stomach," 2nd Edition. Kimpton. P. 14.

amount of lubrication, and materially assists the passage of the tube.

3. *Obstructions in the œsophagus itself.*—We may encounter spasm, stricture, diverticula, neoplasms, and pressure from without. Spasm will usually relax after a short time and allow the tube to pass. But, in any event, no force must be used, and if the tube cannot be induced to enter the stomach we must desist from our attempts until a more thorough examination has demonstrated the absence of a mechanical obstacle.

Contra-indications to the Passage of the Tube.—The following contra-indications to the use of the stomach tube are slightly condensed from the writings of eminent authorities. Van Valsah and Nisbet * say that it should not be used under the following circumstances :—

Severe acute diseases of the throat and stomach, general peritonitis and perigastritis.

Advanced soft carcinoma and ulcer.

If it can possibly be avoided, not in old age, adynamic diseases, uncompensated cardiac disease, degeneration of the heart muscle, arterio-sclerosis with history of a past hæmorrhage, advanced renal disease, cyanosis.

Rarely during pregnancy, and never if there is a history of a previous abortion.

In all cases of recent hæmorrhage its use should be deferred.

Hemmeter's † list is as follows :—

1. *Constitutional and local conditions which would be aggravated by lavage :—*

Pregnancy, heart disease in a state of decompensation, aneurism of the large arteries, recent hæmorrhages of all

* Van Valsah and Nisbet, *op. cit.* p. 89.

† Hemmeter, *op. cit.* p. 119.

kinds, advanced pulmonary tuberculosis, advanced pulmonary emphysema with bronchitis, apoplexy and cerebral hyperæmia, advanced cachexia, continued and remittent fever.

2. *Stomach and Intestinal Diseases : —*

Ulcer with recent hæmatemesis, palpable carcinoma of the pylorus with vomiting of coffee-ground material and the classical symptoms of cancer, stomach and intestinal affections attended with acute fever, gastric mucosa easily started to bleeding, secondary gastric affections whose dependence upon a more important and distinct primary disease is evident.

All these rules may, I think, be reduced to two axioms. *Firstly*, do not pass a tube when your common sense tells you that you may do harm with it, and, *secondly*, do not do so for purely diagnostic purposes when you already know by other signs and symptoms what is the matter with the patient.

CHAPTER II

INFLATION OF THE STOMACH FOR DIAGNOSTIC PURPOSES

Information gained by inflation—Contra-indications—Method of Frerich by liberation of carbonic acid in the stomach—Method by means of the atomiser bulb—Spivak's method by auto-inflation.

It is now generally recognised that inflation of the stomach, unless contra-indicated, is a necessary and routine part of the physical examination of patients with chronic gastric trouble. Unaided by inflation, the results of palpation and percussion are often unsatisfactory and misleading. In fact, it is usually impossible to define the lower margin of the stomach. But if we moderately distend the stomach with gas or air, it will rise beneath our examining fingers as a rounded body the size and exact position of which can often be made out by simple inspection, and usually without any difficulty by palpation and percussion. We must make allowance for the fact that after inflation the stomach will appear nearly an inch larger in every direction than it really is. By inflation of the stomach we shall be able to recognise :—

(*a*) *Gastroptosis.*—In the normal stomach we are unable to make out the lesser curvature. Whenever we can do so, we have to deal with either a

case of gastroptosis or of vertical displacement of the stomach.

In a case of gastroptosis, as the stomach expands we shall observe it rising into prominence at or below the umbilicus, whilst the epigastric region remains hollow and scaphoid. The position of the stomach will be more or less transverse although the pylorus is lowered. But an important point is that on inflation, the upper margin of the resonance due to the fundus does not rise higher than a horizontal line drawn through the seventh costal cartilage when the patient is in the erect position.

(*b*) *Vertical stomach.*—In this condition the inflated stomach will obviously occupy the left lateral half of the abdomen, and the upper margin of the stomach resonance may rise as high as the fourth left costal cartilage.

(*c*) *Dilation of the stomach.*—The lesser curvature of the stomach will not be disclosed by inflation, but will be hidden beneath the liver and the margin of the ribs. The lower margin will be at or below the umbilicus, varying according to the amount of dilation.

Dr. Saundby, in a recent valuable paper,* classifies dilation of the stomach as follows :—

"I do not consider the stomach dilated unless the great curvature comes below the level of the umbilicus, and only slightly dilated if the great curvature does not come down below the level of the anterior superior spines; below that line and half way to the pubes I call marked dilatation, whilst anything below that I regard as extreme dilatation."

* "Observations on Motor Insufficiency and Dilatation of the Stomach," *Brit. Med. Journal*, Nov. 29, 1902, p. 1694.

(*d*) *Tumours of the Stomach.* — Considerable light may often be thrown upon the nature of a tumour by inflation of the stomach.

1. When the tumour belongs to the stomach, it is more distinctly separated from the surrounding organs and may approach the surface and be more readily palpated.

(*a*) Those of the greater curvature and anterior wall will be pressed forward and become more evident.

(*b*) Those of the lesser curvature tend to disappear, being pressed backwards.

(*c*) Those of the pylorus move towards the right and either upwards or downwards, according to circumstances. If a tumour in the region of the pylorus disappears during inflation, although palpable before, it usually denotes that the pyloric pouch is dilated.

2. Tumours of the left lobe of the liver will move forwards and upwards.

3. Tumours of the colon and mesentery will move downwards.

3. Tumours of the spleen will move outwards, downwards, and forwards.

(*e*) *Pyloric incontinence.*—This condition will be revealed on inflation of the stomach by the fact that it is almost impossible to fill the stomach sufficiently to make out its outline, the air escaping into the duodenum as fast as it is introduced into the stomach. If inflation be attempted when the stomach contains liquid, on auscultation the air may often be heard bubbling through the pylorus.

Contra-Indications for Inflation of the Stomach. —We must not attempt to inflate the stomach whenever there is a possibility of doing damage to

the organ. The conditions in which this might occur are :—

1. Acute inflammation of the stomach.
2. Perigastritis.
3. Ulceration of the stomach. In this affection the stretching of the stomach walls might bring on dangerous hæmorrhage.
4. In advanced malignant disease. In the early stages the procedure is probably harmless and may be useful for diagnostic purposes. In advanced cases we can gain no useful information by inflating the stomach, and we might do a great deal of harm.
5. In obvious stenosis of the pylorus of a non-malignant nature we shall gain nothing, as we can learn nothing which we should not already know.
6. When from the clinical history there are probably adhesions between the stomach and neighbouring organs, we must never use the method by evolving carbonic acid in the stomach. We may, if necessary, cautiously use inflation with the bulb, taking care to stop on the first occurrence of pain or uneasiness.

There are three clinical methods of inflating the stomach : by the evolution of carbonic acid in the stomach, by blowing air into the stomach by means of the bellows of a spray apparatus, and Spivak's method of auto-inflation.

By the Evolution of Carbonic Acid in the Stomach.—This was the earliest method and was suggested by Frerich,* who administered 30 grains of tartaric acid dissolved in a little water, and immediately afterwards 35 grains of bicarbonate of soda. Effervescence ensuing in the stomach, a

* H. v. Ziemssen, " Klin. Vortrage," 1883, No. 12, p. 13.

sufficient quantity of gas was evolved to assist in partially inflating it and materially assist in palpation and percussion. The objection to this method is mainly that the amount of distension of the stomach is not under control. Whilst the size and distensibility of the stomach varies in different subjects, the gas evolved is constant in volume. We shall consequently in some cases inflate the stomach not enough and in others produce an uncomfortable and even dangerous state of distension. For this reason this method has practically, of late, become obsolete among those who specialise upon diseases of the stomach, who employ in preference the procedure devised by Runeberg * of blowing air into the stomach through an ordinary stomach tube by means of the double bulb of a spray producer, retaining, however, Frerich's method for use in cases where a tube cannot be tolerated. Saundby † has recently advocated the employment of much larger quantities, according to the technique of Meinert, of Dresden, and uses 120 grains of bicarbonate of soda with 90 grains of tartaric acid, and states that he gets better results than by other methods. This is, however, contrary to my own experience and that of most other workers. In my own practice I never use this method whenever I am able to pass a tube into the stomach, but when the patient will not allow this to be done employ it as a substitute in default of the better one. I attempt to get over the disadvantages inherent in the method by graduating the amount of material

* Runeberg, "Ueber kunstliche Aufblahung des Magens und des Dickdarms durch Einpumpen Von Luft." "Deutsches Archiv. f. klin. Med.," vol xxxiv. p. 460.

† *Loc. cit.* p. 1693.

used to the apparent size of the stomach, as made out by ordinary percussion and palpation. I also find it masks the taste of the tartaric acid solution to add to it a small proportion of sugar. My formulæ are the following:—

Formula 1. The lower margin of the stomach is apparently not lower than midway between the ensiform cartilage and the umbilicus.

Solution A.	Tartaric Acid... ...	30 grains.
	Sugar	10 grains.
	Water	2 oz.
Solution B.	Bicarbonate of Soda	40 grains.
	Water	2 oz.

Formula 2. The lower margin of the stomach is at or about the level of the umbilicus.

Solution A.	Tartaric Acid ...	60 grains.
	Sugar	20 grains.
	Water	2 oz.
Solution B.	Bicarbonate of Soda	80 grains.
	Water	2 oz.

Formula 3. The lower margin of the stomach is an inch or two below the umbilicus.

Solution A.	Tartaric Acid ...	90 grains.
	Sugar	30 grains.
	Water	2 oz.
Solution B.	Bicarbonate of Soda	120 grains.
	Water	2 oz.

My third formula thus corresponds with Dr. Saundby's as to the amount of active ingredients. When the lower margin of the stomach is lower than this, I do not think that it can be efficiently inflated by this method, and never attempt it.

It is better in practice to have the alkali slightly in excess than to proportion the acid and soda strictly according to their combining weights.

Technique of Inflation of the Stomach by the Evolution of Carbonic Acid.—The operation should be performed at the time when the stomach of the patient is most likely to be empty—before breakfast or five or six hours afterwards. The patient should lie upon a couch with his clothes arranged so as to expose the abdomen. Make out the position and size of the stomach as well as possible by percussion, and mark it upon the skin with a dermographic pencil. Dissolve the tartaric acid and sugar in the water in a glass which has some distinctive mark, one made of blue or coloured glass answers very well. Dissolve the soda in another tumbler. It is important to know which is the acid solution, as it should be given to the patient before the other; and as the solutions are made before the commencement of the procedure, some distinctive mark is necessary. The advantage of giving the acid solution first is mainly that the carbonate of soda will neutralise any of the acid adhering to the mouth and teeth and prevent any injurious action upon the latter. The patient now sits up, drinks the acid solution first, waits a minute to allow it to completely reach the stomach, and then swallows the alkali. He then lies down, breathing gently and regularly through the nose and steadfastly resisting the desire to eructate. The operator immediately places the flat of his left hand upon the region of the stomach, which he will feel distending under his fingers. He should learn all he can by palpation as rapidly as possible,

taking care not to manipulate the organ more than necessary for fear of causing an eructation. The outline of the stomach is then to be percussed out with light strokes and marked upon the skin with blue pencil. The patient may now be allowed to eructate, and any slight discomfort will usually subside in a short time. Saundby (*loc. cit.*), in referring to the largest doses, says:—

"I have rarely seen any pain produced, and it has never been more than trifling and temporary in character."

I have, however, seen several cases in which extreme distress and dyspnœa were produced, and it is as well, therefore, to have a stomach tube at hand, which can be passed if it is absolutely necessary to relieve the patient from a dangerous degree of distention. As a rule the difficulty is not that the stomach becomes too distended, but that we cannot evolve enough gas within it to materially assist us in our diagnosis. For this reason the other methods which are under perfect control are to be preferred whenever it is possible to pass a tube.

Inflation by Rubber Bulb. — As already stated the inflation of the stomach is a routine and necessary expedient in all cases where it is imperative to make out with precision the size and position of the stomach and to acquire information as to the relation of tumours to it. In addition to the imperfect method described by means of an effervescing powder, we have better ones which, however, involve the preliminary passage of a tube into the stomach.

The most generally used method is by means of the double bulb of an atomiser.

The patient, lying on his back on a couch, as already described, and a small tube having been passed, to which the inflating bulb has been attached by a suitable connecting mount (see page 88), the stomach is now slowly and cautiously inflated, the operator keeping his other hand flat upon the epigastric region in order that he may recognise the size and position of the stomach as it expands under it. Inflation should cease as soon as the stomach has attained sufficient size for the purposes of examination, or as soon as the patient experiences any considerable degree of discomfort. The operator now as quickly as possible percusses out the stomach with light strokes, and marks its boundaries on the skin of the abdomen with the blue pencil. The next step is to relieve the patient from his condition of discomfort by allowing the air to escape from the stomach. This you do by disconnecting the bellows from the stomach tube, and gently massaging the stomach with the flat of your hand.

It not unfrequently happens, when the stomach contains food residues, that as soon as the tube has been introduced some will be ejected by involuntary expression on the part of the patient, and most likely on to the coat sleeve of the operator. As it is impossible to provide that all patients shall come to one's consulting rooms with empty stomachs, and as a preliminary lavage needlessly complicates the examination, I now employ a method which consists in using as the connection between the bellows and the stomach

tube a T-shaped glass tube which carries on its lateral arm a length of rubber tube provided with a screw clip. This is open when the stomach tube is introduced, its lower end having been placed in a pail or wide-mouthed bottle or other convenient receptacle. If any food should escape

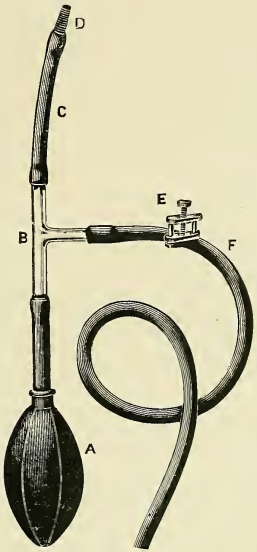

FIG. 4.—The Author's Apparatus for diagnostic Inflation of the Stomach.

from the patient's stomach, it will pass down this tube, and the stomach will empty itself by syphonic action. As soon as this has taken place, or if it is observed that no food is being ejected from the stomach, the clip is screwed up tight and the inflation of the stomach is proceeded

with. This arrangement of apparatus also has the additional advantage that by opening the clip air can at any moment be allowed to escape from the stomach of the patient, without removing the stomach tube, if it is found that too much distress is being produced, or should any untoward symptoms arise.

The arrangement of the apparatus is well shown in Fig. 4.

Auto-Inflation.—This valuable method of inflating the stomach was suggested by Dr. Spivak of Denver, Colorado, and I cannot do better than quote extracts from his paper upon the subject, which appeared in the *Philadelphia Medical Journal* of February 5, 1900.

"1. My method is based upon the following physiological fact: When the stomach tube is in place it in no way interferes with respiration or vocalisation . . . Why should not the patient blow into his own stomach? . . . (to carry out this idea) I bored a side opening in the tube at such a distance from the proximal end that when the tube is introduced into the stomach the opening should be situated in the anterior portion of the buccal cavity. I then clamp the free end of the tube and ask my patient to shut his lips and blow up his cheeks. The air in the mouth, having no other exit, finds its way through the side opening into the stomach. The patient is told as a matter of course to breathe through the nose between the acts of blowing up the cheeks, and to keep the mouth shut until the end of the examination: otherwise the air will escape from the stomach through the side opening.

"The advantages of my method can be summed up as follows:—

"1. No other apparatus is required except the stomach tube.

"2. The method is absolutely under the control of the physician. The quantity of air can be increased, diminished or kept stationary.

"3. The procedure is harmless, since the patient will never over-distend his own stomach.

"4. It will not cause any irritation of the mucous membrane of the stomach (as a tartaric acid solution might do).

"5. The hands of the physician are perfectly free to palpate or percuss the patient."

The apparatus is shown in the accompanying sketch (Fig. 5). (*a*) Side opening. (*b*) Teeth mark. (*c*) Sliding ring. (*d*) Glass tube. (*e*) Clamp. The tube is introduced until the mark (*b*) is level with the incisor teeth. This is the average distance required for the end of the tube

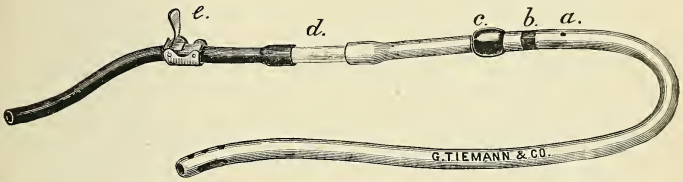

FIG. 5.—Spivak's Tube for Auto-inflation of the Stomach.

to enter the stomach. In cases of dilatation or gastroptosis it will not of necessity require to be introduced any further, as the cardiac orifice of the stomach is practically fixed, and as long as the open end of the stomach tube passes beyond this inflation can be efficiently carried out. When the tube is first introduced the clamp (*e*) should be open in order to allow any stomach contents, which may be forced out of the stomach by involuntary straining of the patient, to pass into a convenient receptable. After this has taken place, or one finds that no food is ejected, it may be closed and the auto-inflation of the

stomach proceeded with. If desired, a preliminary lavage of the stomach may be performed by means of this tube. The object of the hard rubber ring (*c*) is to be able to close the hole when it is required to use the tube for ordinary syphonage.

CHAPTER III

EXTRACTION OF THE STOMACH CONTENTS

Object of extraction of stomach contents—Dunham's tassel—Turck's capsule—Einhorn's stomach bucket—Salzer's method — Expression — Aspiration — Precautions when aspirating—Food residues and their significance—The water test, Mathieu's and Van Valsah's respective methods.

Our object in extracting portions of the contents of the stomach may be grouped under the following headings :—

1. To ascertain whether the stomach contains food residues, mucus, or gastric secretion at a time when it should normally be empty.

2. To extract and examine test meals at different stages of the digestive process, with the object of ascertaining by chemical and other tests whether it is carried on in a normal manner.

3. To search for pus, blood, fragments of mucosa and bacteria in the stomach in cases where the presence or absence of such may be a factor in the diagnosis.

It is important to bear in mind that for purposes of chemical analysis any material which may be removed in the washing water during lavage is almost useless, as it would be largely diluted with water. Even if we knew exactly the quantity of

water which had been used in the process of lavage, a long and difficult arithmetical calculation would be required before we could deduce the actual composition of the stomach contents. It is therefore necessary to be able to extract portions of the stomach contents without the admixture of water, and certain special methods have been devised for the purpose.

Before discussing the ones which have proved of practical utility we will describe a method recently devised by Dunham,* for roughly testing the acidity of the stomach contents *in situ*. The idea is not entirely original, since Spallanzani over one hundred years ago attempted to ascertain the composition of the gastric secretion by causing persons to swallow little balls of pith, saturated with reagents and attached to the ends of pieces of thread. Dunham, however, has developed the idea and devised a method which may possibly be of practical use.

Dunham's Tassel.—This method consists in making the patient swallow a piece of thread saturated with certain reagents, such as litmus, congo red, or dimethyl-amido-azo-benzol, which are acted upon by the acids of the gastric juice. The apparatus consists of thirty inches of stout thread carrying at its distal extremity a small tassel, its other end being attached to a reel of wood. The tassel is saturated in the reagent, preferably dimethyl-amido-azo-benzol, and allowed to dry; the thread is wound upon the reel, which is placed in a beaker of water. The tassel is then passed into a short length of glass tube. The

* New York University Bulletin of the Medical Sciences, October, 1901, vol. i., No. 4, p. 178.

patient takes the glass tube, and placing the tassel end in his mouth and the other one in the water below the level of the reel, swallows the water through it. This will carry the tassel down into the stomach. After a few minutes the thread may be withdrawn, when the tassel will exhibit the colour reaction indicating the condition of the stomach contents as regards free HCl. The whole operation is so easy and devoid of inconvenience to the patient, that if necessary, several tassels saturated with different reagents may be swallowed in succession. Or two or more tassels may be attached to the same piece of thread. In this case it is necessary to have some distinguishing mark, such as a difference in length, by which the different tassels may be differentiated. The apparatus may be easily constructed from a small empty cotton reel, and a skein of ordinary unbleached thread, the tassel being made by cutting bodily a piece about half an inch in length from an unwound skein and tying the end of a long piece round its centre. With a fine bradawl bore a hole through the centre of the cotton reel, pass the other end of the thread through, and tie it. You must be especially careful to secure the thread to the reel, otherwise there is danger of it becoming detached and being swallowed by the patient.

We now come to the methods of extracting portions of the stomach contents for purposes of examination. The first of these, viz., that of F. Turck, resembles in its main idea the method of Dunham just described, but differs from it in the fact that a small quantity of the contents of the stomach is really extracted.

Turck's Capsule.—This is another very ingenious

attempt to solve the problem of ascertaining the composition of the gastric juice without the introduction of a tube, and is decidedly useful in practice. In many cases the diagnosis of a given case practically hinges upon the point whether or no free hydrochloric acid is present in the stomach. By this little piece of apparatus we are enabled to set this point at rest and, moreover, to obtain sufficient of the stomach contents to submit to a microscopical examination. The apparatus consists of a little piece of thin rubber tube attached to the end of a silken thread, and carrying, passed

FIG. 6.—Turck's Capsule closed.

FIG. 7.—Turck's Capsule after Solution of the Gelatinous Envelope.

through slits made in it, a slip each of blue litmus, congo red, and dimethyl-amido-azo-benzol paper. The rubber tube is doubled up and enclosed in a gelatine capsule. In this condition it may be swallowed by the patient with perfect ease. In the stomach the gelatine capsule is dissolved, the test papers are acted on by the stomach contents, and the rubber tube fills itself by capillary action with the material with which it comes in contact. After sufficient time has elapsed (about fifteen minutes) the silken cord with its attached rubber tube is drawn up, the test papers inspected, and

the stomach contents which fill the rubber tube squeezed out into a porcelain dish. Enough will have been obtained not only for microscopical examination, but also for the performance of a qualitative test for free HCl.

The capsules may be purchased ready-made from Truax and Greene, Wabash Avenue, Chicago, and Down, 21, St. Thomas's Street, London, or may be readily manufactured at home in the following manner. We shall require :—

1. Some surgical ligature silk. The plaited kind is safest and best.

2. Some perforated shot of large size, as used by anglers for weighting fishing lines.

3. Some pieces of unvulcanised rubber tube, such as is used to form the valves of Dunlop bicycle tyres, cut into half-inch lengths.

4. A box of Platen's capsules, No. 00.

5. Some darning cotton soaked in blue litmus, congo red, or dimethyl-amido-azo-benzol. (See page 58.) When making the capsules yourself it is much easier to use test cotton than test paper, as it is almost impossible to thread strips of the latter through the rubber tube.

6. A few darning needles.

Proceed as follows :—

Cut the tube into lengths of half an inch. Cut the ligature silk into lengths of about 2 feet. Cut the test cotton into lengths of several inches.

Now take a darning needle and thread it with a piece of the test cotton and transfix each rubber tube with the three kinds at equal distances. Cut off the cotton on each side so that it projects a quarter of an inch. Now take a piece of the ligature silk, tie a shot at one end and thread the

other through a needle. Thread it through the rubber tube. Pass the needle from the inside through the bottom of one half of a Platen capsule, double up the rubber tube and pack it inside the capsule. Wet the sides of the capsule and put on the other or outer half. The Turck capsule is now complete. Finish by making a knot on the thread 16 inches from the capsule, to indicate by its approach to the teeth when the capsule has probably reached the stomach.

Method of using the Turck capsule :—

One hour after an Ewald test breakfast (see page 51) let the patient swallow the capsule. This is readily done by placing it on the back of the tongue and giving him a drink of water, exactly in the same manner as Einhorn's stomach bucket (see page 38). If the patient sucks the capsule for a short time before taking the water it will become slippery and be much easier to swallow. As the capsule descends into the stomach the silk will be drawn slowly into the mouth, and when the knot has reached the teeth we may presume that it has reached the cardia. We allow 4 inches more of the thread to pass the teeth. The patient can now sit down and read a book for a few minutes, the presence of the thread in the throat not causing the slightest inconvenience. At the expiration of fifteen minutes it may be assumed that the capsule has dissolved, and you may pull out the silk by gentle traction. Not the slightest difficulty will be experienced in doing this, as the rubber tube will have straightened itself out by its elasticity and will offer no obstruction. You must have a small, clean beaker or saucer ready to receive the tube as soon as it has escaped from the mouth.

(*a*) If the stomach contents are neutral all the papers will be unchanged in colour.

(*b*) If there is no free acid, but only combined acid and acid salts, the litmus will have reddened, but not the other two pieces of test papers.

(*c*) If there is free organic acid, but no free hydrochloric, the congo red will be turned a blackish blue, but the dimethyl paper will be unchanged.

(*d*) If there is free HCl all three papers will be acted on. The litmus will be red, the congo red will be blue, and the dimethyl will be red.

(*e*) If both HCl and lactic acid are present the congo red paper will not be a pure blue, but have a blackish tinge.

As an example of the usefulness of the capsule, we may take a case of evident pyloric obstruction.

1. We find the litmus reddened, the congo red of a blackish blue, the dimethyl paper not changed. Methyl violet is unchanged when added to a drop expressed from the rubber tube, and a microscopical examination shows the Oppler-Boas bacillus in abundance. The diagnosis will be probable malignant disease.

2. We find the litmus reddened, congo red paper pure blue, dimethyl paper bright red; methyl violet changed to blue; sarcinæ in abundance, but no Oppler bacillus; the chances are we have a case of non-malignant stenosis of the pylorus.

Einhorn's Stomach Bucket.—Dr. Einhorn also has devised an ingenious apparatus for obtaining small quantities of the stomach contents without the passage of a tube. It consists of a small silver bucket of oval form attached to a stout piece of silk. This can be swallowed by the patient, and

drawn up again, bringing with it about 2 cc. of the gastric contents.

As I have had personally very little experience with it, having yet to find a patient who would not allow a tube to be passed if necessary, I quote the following description of it from the inventor's work upon diseases of the stomach.*

"The bucket consists of a small capsule-shaped vessel ($1\frac{3}{4}$ cm. long, $\frac{3}{4}$ cm. wide), made of silver; on the top there is a large opening surmounted by an arch to which

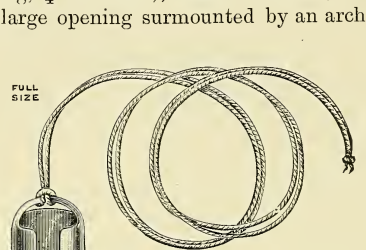

Fig. 8.—Einhorn's Stomach Bucket.

a silk thread is tied, and a knot made at a distance of 16 inches from the attachment.

"Method: In order to obtain a sample of the stomach contents, proceed as follows:—

"The bucket is dipped into lukewarm water, filled and emptied (this serves to make the inside of the vessel moist, so that it will more easily take up the contents of the stomach). Then the patient is asked to open his mouth widely and the bucket is placed on the root of the tongue (almost in the pharynx); the patient should now swallow once or twice.

* "Diseases of the Stomach," by M. Einhorn. London: Bailliere. 2nd Edition, p. 62.

"The vessel after a short time (one or two minutes) enters the stomach. As soon as the knot of the thread is at the lips the bucket is in the stomach, for the distance from the teeth to the cardia is usually 16 inches. The vessel is left there for about five minutes, and then withdrawn. During the withdrawal a resistance is usually felt at the introitus œsophagi. To overcome this difficulty, when the apparatus is at that narrow point the patient should swallow. By the act of swallowing the larynx is pushed forwards and upwards, and thus the passage is free and the bucket can be easily withdrawn."

For a method of testing such small quantities of stomach contents as are withdrawn by the stomach bucket, see page 58.

By the Stomach Tube alone without Expression or Aspiration.—This is a method specially advocated by Salzer,* and, like the preceding ones given, may be used when we require only a small quantity of the stomach contents. A soft rubber stomach tube is introduced into the stomach until a mark 20 inches from the eye is level with the teeth. In tall persons, or in cases where there is splashing below the umbilicus, it should be introduced 24 inches. This tube is allowed to remain *in situ* for a few minutes, or until retching occurs. You may now withdraw the tube, at the same time nipping the open end between the finger and thumb of the right hand, so as to prevent its contents from escaping. Hold it vertically over a clean beaker or dish and relax your pressure, and blow a little air through it with the ball used for clearing stomach tubes during lavage (see page 41), and

* Salzer, "Journal of the American Medical Association," 1896, No. 2, p. 68.

you will find that you have secured about 6 cc. of the gastric contents, in fact, quite enough for the qualitative tests for hydrochloric acid, for rennin and for microscopical examination. (See method of testing small quantities of stomach contents, page 58.)

The next method, that of expression, is but an extension of the above, and is advocated, I think erroneously, by most writers on diseases of the stomach as the routine method to be used in ordinary practice. Personally, I think that we can obtain the stomach contents with less discomfort to the patient and certainly with as little risk by aspiration, provided that we use a proper apparatus and pay attention to the special points of technique.

Expression.—The tube is passed into the stomach in the usual manner. The patient is directed to strain as if about to pass a stool. Usually a gush of stomach contents will flow from the open end of the tube, which we catch in a vessel held ready in position. A better way is to attach two or three feet of rubber tube to the end of the stomach tube, so that the flow of fluid along the whole length of the tube may set up syphonic action and the flow continue after the straining effort of the patient has ceased.

If we are unable by this method to obtain any flow of stomach contents, one of the following conditions must be present:—

1. The tube may be improperly placed in the stomach. If it has not been introduced far enough the eye will not be immersed under the surface of the liquid in the stomach. If it has been passed too far the end will curl upwards,

following the greater curvature until the eye emerges from the surface of the stomach contents. In each of these two events it is obvious that nothing can pass into the tube and the expression will fail.

2. The tube may become blocked by a particle of food or a lump of mucus.

3. In cases of atonic dilatation of the stomach the abdominal pressure exerted by the patient may, from mechanical reasons, not be able to expel the contents of the stomach.

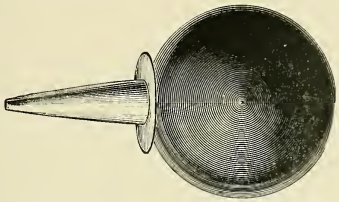

Fig. 9.—Blower for Clearing blocked Stomach Tubes.

4. The patient, from muscular weakness of the abdominal muscles, may not be able to strain and exert the necessary pressure.

5. The patient may be stupid and unable to understand the kind of effort which he is required to make.

6. The test meal may have passed into the duodenum.

The first thing to do if a flow of fluid does not take place, is to alter the position of the tube by pushing it further in and pulling it further out. We may do this with impunity, because no suction is being exerted. If we still fail to obtain any stomach contents, we blow sharply a little air through the tube to remove anything which may

be blocking it. The best apparatus to do this with is a small ball enema provided with a special conical nozzle of such a size as to enable it to fit any of the different sized stomach tubes in our outfit. Fig. 9 represents a blower made for this purpose, at my suggestion, by Messrs. Down Brothers. We should invariably have this at hand when performing lavage or extraction of the stomach contents, as the tube may become blocked at any moment.

If we are still unable to withdraw any stomach contents and have ascertained that conditions 3, 4, and 5 are not present, the patient's stomach must be empty. If there is any doubt upon this point we should proceed to aspiration and finally, if it is important to know whether such is the case, perform lavage. In such a case we introduce about 10 ounces of water and syphon it off. If it comes away clear, we can be sure that the stomach is empty. It is therefore always advisable to have the funnel attachment and the warm water ready in case they may be required, for if we had to leave the patient to go and search for them during the operation, the favourable moment would have passed unutilised.

Aspiration.—Of all the methods of extracting stomach contents for examination, the most practical is undoubtedly aspiration, and with ordinary care it is perfectly safe.

The simplest form of aspiration is to insert the nozzle of a collapsed ball enema, as shown in Fig. 9, into the open end of a stomach tube *in situ*, and allow it to expand slowly. Sufficient material can be extracted in this manner for an ordinary examination.

A more convenient device is the Turck's aspirating bottle, shown in Fig. 10.

Its construction is simplicity itself. It consists merely of a wide-mouthed upright bottle of a capacity of 20 ounces. The bottle is closed

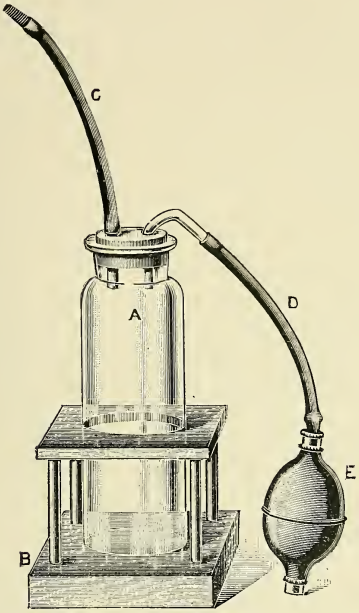

Fig. 10.—Turck's Aspirating Bottle, with the Author's connecting Mount and weighted Stand.

by a rubber cork, 2 inches in diameter, pierced with two holes through which pass bent glass tubes. One of these carries a short rubber tube terminating in an exhausting bulb. The other is intended for insertion into the open end of the stomach tube. As stomach tubes vary in size,

I have found it convenient to modify Turck's original apparatus by increasing the calibre of this tube, and attaching it to a short length of rubber tube terminating in one of the connecting mounts described on page 88. We can thus adjust it to any sized tube which we may be using. This piece of tube should be stiff enough to withstand a considerable amount of negative pressure without collapsing. As we are unfortunately prevented from using proper aspirator tubing from the smallness of its calibre, it is better to sacrifice an old stomach tube and cut off a piece sixteen inches in length and make use of this for the purpose. This will be found to have walls of just the right thickness. The exhausting bulb is constructed on the same principle as the bulb of a spray producer, with the difference that the valve is reversed. It will, therefore, when compressed, exhaust instead of inflate.

In order that the aspirating bottle may be used with safety, we must make it an absolute rule not to shift the position of the stomach tube whilst any suction is taking place. Otherwise we may tear off a strip of mucous membrane from the interior of the stomach. We must also use a proper tube, as described on page 5. One of the ordinary English tubes, with sharp cutting eyes like curettes, must be carefully avoided. It will be found convenient in practice to place the aspirating bottle in a wooden stand upon the table, at such a height that the end of the tube, when drawn upwards to its full extent, will be at the level of the stomach tube in the patient's mouth. You have thus both hands at liberty. Such a stand is shown in Fig. 10.

Everything being in readiness, you pass the stomach tube, connect it with Turck's bottle by inserting the conical connecting mount into the open end of the stomach tube, and commence to gently compress and relax the exhausting bulb. If the stomach contents are seen to be flowing into the bottle you continue, only working the bulb when the flow ceases, so as not to exert a greater exhausting force inside the stomach than is absolutely necessary. If, however, no fluid flows, *disconnect the stomach tube* and move it a couple of inches further in. If still no fluid flows, *disconnect it again* and push it in a little more. Continue this until you find the fluid or are certain that the stomach is empty. I cannot repeat too often that you must disconnect the mount from the stomach tube before moving the latter. As you do so, you will hear the air whistle into the stomach tube, showing that there was such suction within it that if you had moved it you might have damaged the interior of the stomach. The great secret is to try systematically for stomach contents at different levels. You will thus never fail in extracting the stomach contents, if there are any, and if you will acquire the habit of never shifting the position of a tube in the stomach under suction, without disconnecting it from the other apparatus, you will never have an accident.

After you have obtained sufficient stomach contents, you remove the rubber cork from the aspirating bottle and replace it by a well-fitting glass stopper, which is supplied with the apparatus.

In addition to its use in procuring portions of test meals for examination, we use the process

for ascertaining whether the stomach contains anything at a time when it ought properly to be empty. This may be either food residues, or fluid which we have introduced ourselves with the object of acquiring information as to the normality of the muscular power of the stomach. We will first briefly discuss the significance of food residues and the precautions which must be observed in obtaining them, and then describe the water test which, although quite indispensable in the diagnosis of stomach affections, appears to be practically unknown and unused in England.

Food Residues.—As examples of the valuable information which we may gather from simply ascertaining whether the stomach contains food residues or fluid when it should normally be empty, we will take the following common examples likely to be met with in practice, and state the deductions which we may legitimately make:—

1. The stomach, having been washed out the previous night, contains fluid rich in hydrochloric acid in the morning before breakfast.

The patient is suffering from Reichmann's disease or permanent hyper-secretion.

2. The stomach is empty before breakfast, but at 1 p.m. contains the remains of the patient's breakfast.

The patient is certainly suffering from some defect in the motility of the stomach, probably myasthenia of the second degree.

3. The stomach before breakfast contains food *débris* from the late dinner of the day before.

We come to the conclusion that there is either myasthenia of the third degree, that is, with retention of food, or that there is some degree of

pyloric obstruction, which, we shall be able to tell by—

The Water Test.—This is a very ingenious test for estimating how much water passes out of the stomach in a given time, and is especially useful in the differential diagnosis of myasthenia gastrica and pyloric obstruction.

There are two distinct methods of performing this test—that of Mathieu, and that devised by Van Valsah and Nisbet.

*Mathieu's Method.**—The following is a free translation of his directions :—

"After having extracted a certain quantity of the stomach contents, one adds to the remainder a given volume of distilled water, making it pass backwards and forwards between the stomach and funnel until the mixture is complete. You now extract as much as possible of the diluted gastric juice.

"Let v represent the quantity of liquid extracted in the first instance before dilution, a the acidity of this liquid, a' the acidity of the diluted stomach contents, and q the quantity of distilled water introduced into the stomach.

"The quantity of acid in the stomach contents being manifestly the same both before and after dilution, we get the following equation :—

$$ax = a'q + a'x$$

From which we can derive—

$$x = \frac{a'q}{a - a'}$$

* A. Mathieu, "Therapeutique des Maladies de l'Estomac," 5th Edition, p. 18. Paris: Octave Doin.

Therefore the quantity of fluid originally in the stomach is represented by the formula—

$$V = v + \frac{a'q}{a - a'}$$

This very simple formula enables us to determine what is exactly the quantity of liquid contained in the stomach at the moment of exploration."

*Van Valsah and Nisbet's Method.**—The principle of the test is the same as that just described, but differs in detail. If you introduce 100 cc. of water into the stomach, and some time afterwards another 100 cc. containing 1 per cent. of sugar, and if you now extract some of the stomach contents and find that the percentage of sugar is still 1 per cent., it is obvious that the whole of the original 100 cc. must have passed out of it. If you find that the quantity of sugar is ½ per cent., then we know that the whole of the original 100 cc. must be still in the stomach, and that the sugar has been equally diffused through the total mass of fluid.

The test is actually performed in the following manner: 300 cc. of water are given to the fasting patient the first thing in the morning. One and a half hours later he swallows 100 cc. of water containing 1 per cent. of cane sugar. The patient is placed in the recumbent position and his abdomen gently kneaded to mix up the stomach contents. A stomach tube is now passed, and a few cc. removed by aspiration. It does not matter how much exactly you get up. You now test this quantitatively by the usual method with a solution such as Pavy's or Fehling's.

* *Op. cit.* p. 354.

Then the formula—

$$100 \div \text{per cent. of sugar} - 100$$

will give the number of cc. of the original 300 cc. of water remaining in the stomach.

A normal stomach should have completely disposed of the original quantity of water by this time, and if any be found remaining, then we are absolutely certain that myasthenia exists. This test offers a most practical method of excluding the stagnation of stomach contents due to pyloric obstruction. In all except the extreme degrees of pyloric stenosis, the stomach, whilst more or less unable to deal with solids, is yet, as its muscular power is unimpaired, quite capable of emptying itself of liquid. A myasthenic stomach, on the other hand, finds its greatest difficulty in dealing with water and thin fluids. Of course, we must not forget that the water test will fail in those rare cases of pyloric obstruction which are accompanied by weakness of the muscular walls of the stomach. Such cases are not frequently met with, because long continued, gradually increasing obstruction of the pyloric orifice tends to produce hypertrophy of the muscular coats of the stomach.

CHAPTER IV

THE EXAMINATION OF THE STOMACH CONTENTS

Test meals—Macroscopic examination—Microscopic examination—Qualitative tests for acidity, free acids, hydrochloric acid, combined hydrochloric acid—Quantitative test for acids—Test for the products of starch digestion—Estimation of the digestive power of the gastric juice—Test for mucus, blood, fermentation—List of apparatus and reagents required—A scheme for practising the tests upon artificial solutions.

It is an erroneous idea that the examination of the stomach contents is a difficult matter and only to be carried out by a trained chemist in a properly equipped laboratory. On the contrary, the few simple tests which are called for in daily clinical work are extremely easy, and within the power of every practitioner of medicine. In actual practice a long time is not taken up in making these tests, as the diagnosis may hinge upon the result of one or two of them. In such cases we should naturally confine our attention to the elucidation of the one or more necessary points, and not waste our time by laboriously going through other tests which in the case before us would have only an academic interest. For instance, in acute disorders of the stomach, any examination of the gastric contents will be hardly ever called for; and in chronic

cases, where the diagnosis is reasonably certain, we shall certainly not subject the patient to the ordeal of obtaining the contents of the stomach except in order to be able to prescribe a scientific diet. This is especially the case in gastric neurasthenia, where the characteristic stigmata of the affection are self-evident. But in other cases any opinion which we may form as to the nature of the case will probably be the merest guess-work, unless we ascertain what actually happens to the food after it has reached the stomach.

The necessary preliminary to the examination of the stomach contents is the administration of a test meal. We may extract this either during the height of digestion in order to ascertain the composition of the gastric juice, the progress of digestion, and the presence or absence of substances such as blood, mucus, pus, or micro-organisms which may throw light upon the nature of the affection from which the patient is suffering; or some hours after, when the stomach should normally have emptied itself, in order to find out whether the motility of that viscus is in a normal condition.

Test Meals.—We have practically three test meals in common use:—

Ewald's Test Breakfast.—This consists of 2 or 3 ounces of dry bread and 10 to 12 ounces of hot water or weak tea without milk or sugar. This is the most useful test meal for ordinary purposes, as by its aid we can learn a great deal about the composition of the gastric juice, the particles of bread are finely divided and will not block the eyes of the tube, and the material extracted from the stomach is cleanly and not so

messy as the result of a meat meal. But as it is by no means a severe trial to the capabilities of the stomach, it is in certain cases advisable to give a test meal which makes greater demands upon the powers of digestion and more nearly approximates the ordinary mixed meal of daily life. Ewald's test meal is withdrawn from the stomach between an hour and an hour and a half after it has been taken.

Boas's Test Breakfast.—One disadvantage of the Ewald test meal is that a small amount of lactic acid is contained in the bread. This will vitiate the test when the presence or absence of lactic acid is of great importance, as in the diagnosis of the early stages of cancer. Boas has devised a meal which is free from this defect. The stomach is washed out in the morning until the washing water comes away perfectly clear and with no reaction to litmus paper. Then a meal is given which is made by adding one heaped tablespoonful of oatmeal to one quart of water and boiling until it is reduced to a pint. This should be done in a double saucepan, a "Gourmet boila," or a jar standing in a saucepan of water. After one hour the stomach contents are aspirated and examined. If the meal has been given with these precautions, lactic acid will practically only be found to be present in cases of malignant disease.

The Test Dinner.—This consists of 12 to 14 ounces of strong soup, two slices of white bread, 4 to 5 ounces of minced underdone beefsteak, and 6 ounces of water. The stomach contents are aspirated four hours afterwards. This meal is especially valuable when we wish to ascertain whether the motility of the stomach is normal. It

is then given at seven o'clock in the evening, after a preliminary lavage, and the stomach contents (if any) extracted the following morning before breakfast. The presence of any residues of the test dinner in the stomach would signify that it did not completely empty itself during the night, and would point to retention myasthenia, or to pyloric obstruction. When used for this purpose, we may add with advantage to the menu given above a little plain boiled rice, as this is easily recognised microscopically.

Salzer's * *Double Meal.*—This authority considers that we may save time by giving the test dinner at 9 a.m. and Ewald's test breakfast at 1 p.m., and extracting the stomach contents for examination an hour afterwards. By this procedure we shall have the advantage of finding out whether the stomach is able to digest and dispose of the first meal in four hours, and shall have the second meal of quite distinct materials for subsequent chemical examination. Salzer's menu is substantially as follows: Breakfast consists of 30 to 50 gms. of cold roast meat, free from fat and skin and cut into dice, 250 gms. of warm milk or milk and water, 30 to 50 gms. of toast or zwiebach. Five hours after this meal, he gives 30 to 50 gms. of stale wheat bread without crust or toasted particles, and 300 gms. of warm water or tea without sugar and milk. One hour afterwards the stomach contents are to be extracted. We thus get both meals during the height of their respective digestion.

In the clinic of the University of Baltimore

* Salzer, "Journal of the American Medical Association," 1896, No. 2, p. 68.

Hemmeter uses a double test meal, which, slightly differing in details, has the same essential features as that used by Salzer. Easily recognisable substances are given at two meals, the first one of which taking three or four hours and the second one hour to digest.

*Hemmeter's Double Test Meal.**—At 8 a.m. One small piece of beef, scraped and broiled = 80 gms., one soft-boiled egg, 30 gms. of boiled rice, one glass of milk = 230 cc., and a piece of bread. Four or five hours later an Ewald test meal is given.

Both Salzer's and Hemmeter's meals enable one to form a very good idea as to the digestion in and motility of the stomach by a simple macroscopic examination.

Examination of the Stomach Contents.—After having given the test meal, and extracted sufficient of the contents of the stomach, we proceed to examine it in the following manner:—

Macroscopically. We learn what we can from simple inspection.

Microscopically.

By chemical tests.

By fermentation tubes.

By **simple inspection** combined with a **microscopical examination** we may form a very correct idea of the process of digestion without undertaking any chemical or other tests. And this we shall find especially useful when we are only able to obtain very small quantities of the stomach contents, as in cases where we are restricted to the use of the Turck capsule or the Einhorn stomach bucket.

* Hemmeter, *op. cit.* p. 121.

For instance, after a test meal consisting of meat and bread—

(*a*) If we find very few unaltered starch granules, but that the meat fibres have nearly all lost their transverse striation, digestion is proceeding normally, and there is nothing wrong with the gastric secretion.

(*b*) If we find the starch unaltered, nearly all the bread present in a finely divided condition, but the meat fibres practically all digested and gone, we most probably have to do with a case of hyperchlorhydria.

(*c*) When the starch digestion is evidently good but the meat practically unaltered, we have a case of hypochlorhydria.

(*d*) Starch granules mainly unaltered, meat digesting well, with the presence of an abnormal amount of bacteria and sarcinæ, would point to the probability of the case being one of non-malignant stenosis of the pylorus.

(*e*) Starch digested, meat unaltered, excess of bacteria, especially the Oppler-Boas bacillus, no sarcinæ; probably malignant disease of the stomach.

Hemmeter claims to get from his double test meal the following diagnostic information:—*

"Disappearance of the entire breakfast meal points to a normal digestion.

"Absence of all proteids—beef and egg—and presence of considerable carbohydrates—rice and bread—points to hyperchlorhydria.

"Absence of all carbohydrates, and absence of some of the beef and egg, point to hypochlorhydria, sub-acidity, anachlorhydria or achylia.

"Presence of the entire meal, with perhaps milk

* Hemmeter, *op. cit.* p. 122.

uncurdled, means impaired motility, with atrophy of the gastric mucosa, absence of acid, enzymes, and pro-enzymes.

"If the entire meal has disappeared, the status of the gastric secretions may be ascertained from the Ewald test meal which is still present."

So we see that it is not at all necessary to be a chemical expert to derive considerable information from a quite superficial examination of the stomach contents.

As regards the microscopical examination, sarcinæ are best seen in wet unstained preparations, while the Oppler-Boas bacillus is shown to the greatest advantage in cover-glass preparations stained with methylene blue.

Chemical Analysis of the Stomach Contents.—The first thing to do is to put the matter extracted from the stomach through filter paper. The tests are made upon the clear filtrate. If the filtrate should be dark coloured we can deal with it in the following manner: Procure some coarsely powdered animal charcoal, which must be free from acid or alkali or soluble substance, shake up the filtrate with it and again filter. This process will in most cases decolourise it.

1. Qualitative tests for acidity.

Blue litmus paper.—This is sensitive to all free acids, acid combinations and acid salts—in fact, to all the factors of gastric acidity. It is in consequence invariably the first test which we apply. It gives a distinct reaction with 0·006 per cent. of hydrochloric acid, 0·01 per cent. of lactic acid, and 0·02 per cent. of butyric acid.

Congo red.—This is most conveniently used in the form of filter paper saturated with the aqueous

solution, dried, and cut into strips. It is turned blue by both mineral and organic free acids, but is not affected by acids in combination nor by acid salts. The colour caused by organic acids will disappear on gently warming the paper over a spirit lamp, whilst that due to hydrochloric acid remains unchanged.

2. Tests for free hydrochloric acid.

I may premise by saying that the tests for free hydrochloric acid to which we have hitherto pinned our faith, viz., phloroglucin-vanillin and resorcin-sugar, are absolutely fallacious and useless for clinical purposes. It has been pointed out by Faulkner * that the necessary heating will produce hydrochloric acid in sufficient quantity to develop the colour in most stomach contents which were HCl free at the commencement. For instance, any lactic acid present will decompose sodium chloride with the evolution of HCl. Oxalic acid, binoxalate of potash, and tartaric acid will do the same. And as these substances are common constituents of vegetables, wine and other articles of food, we shall rarely find the stomach contents sufficiently free from them to make the tests mentioned of any practical value. We have fortunately several other tests upon which we can rely.

Dimethyl-amido-azo-benzol.—This is used in the form of a one-half per cent. alcoholic solution, and turns a red colour in the presence of a mere trace of HCl. It also reacts in the presence of solutions of lactic acid and acid phosphates when exceeding 0·5 per cent., but only in the absence of peptone, albumin and mucin, and as such large quantities

* "Journal of the American Medical Association," vol. xxiv. p. 313.

could hardly occur after a test meal preceded by lavage except under circumstances which would be otherwise recognised, it may be used with confidence.

Dimethyl-amido-azo-benzol is conveniently used in the form of test papers. Thin filter paper is soaked in the one-half per cent. solution, dried and cut into strips. By means of this paper a rough estimation of the amount of HCl present may be made in the following manner. With a glass rod place a drop of the stomach contents in a porcelain dish and with the same rod add to it a drop of water. Touch the test paper with the mixture. Now add another drop of water and test again. Continue the dilution until the faintest tinge of red only is communicated to the test paper. After an Ewald test breakfast, if the gastric contents cease to give the reaction before it has been diluted three times, hypochlorhydria is present. Anything dilution between three and six will denote a normal amount of free HCl, and anything above six will show that hyperchlorhydria is present. After the test dinner the figures will be rather lower, as it is a matter of common knowledge that less HCl remains free after a meat or mixed meal than after one of bread alone. This method of testing the stomach contents is especially useful when we can only obtain a small amount, as for instance when we are using the Turck capsule or the stomach bucket.

Methyl violet.—This is one of the most useful and reliable qualitative tests for free HCl. The reaction is obtained by mixing a watery solution of the reagent with the clear filtrate. If an excess of free HCl be present, a green colouration is obtained;

if the acid be present in a normal amount the reaction is blue. Large quantities of HCl would bleach the violet solution, but such an excess is practically never met with in testing the stomach contents. A rapid and easy method of using this test is to take a very small drop of the concentrated solution of the methyl violet upon the end of a glass rod and stir it into a few cc. of the filtrate in a porcelain dish. A rough measure of the amount of acid present may be made by observing the number of drops of stain which can be changed in colour. In cases where the HCl is present in extremely small quantities, it has been recommended by Maly * to evaporate the filtrate down to one or two drops over a water-bath before applying the test. The fallacy of this, as in the case of the Gunsberg test, is that if either lactic acid or oxalates, together with sodium chloride, happen to be present in the stomach contents, HCl will be evolved by their reaction in the presence of heat, and we shall obtain the characteristic colour, although no HCl was originally present.

Benzo-purpurin.—This is a very valuable test and is extremely sensitive. In the presence of free HCl the dark red colour of the solution will change to a light violet. A similar colour, but of a more brownish hue, may be obtained with the organic acids when present in considerable quantity, but the ambiguity may be removed by shaking up the test paper with sulphuric æther. The colour due to the organic acids will be removed, whilst that caused by the HCl will remain. The æther used must be neutral to test paper, or the reaction will fail.

* Maly, "Zeitschr. für physiol. Chemie," i. 174, 1877.

3. Qualitative test for combined hydrochloric acid.

When the presence of free hydrochloric acid has been demonstrated, there will be no necessity to test for it in combination. It is obvious that no hydrocloric acid can remain free as long as there is any albumen remaining uncombined. But if you can find no free hydrocloric acid, and the blue litmus paper has given an acid reaction, we may find out whether the acidity consists mainly or partly of combined HCl in the following manner :—

Neutralise the filtrate, boil, add acetic acid, and sodium chloride, boil again, and filter after cooling. We shall now have precipitated all the uncombined albumen, and all which remains must be digested proteid in combination with HCl. We apply the biuret test, and a rose reaction will show us the presence of propeptone.

4. Test for the presence of lactic acid.

Uffelman's test, which is so generally recommended in the clinical manuals, is practically useless, as alcohol, sugar, and acid phosphates give reactions very similar to lactic acid. Butyric acid also gives a reaction very difficult to distinguish. The well - known iodoform test is not suitable to clinical work mainly on account of the large amount of æther which has to be used and subsequently evaporated. A much better and more practical method is the following : Distil 40 cc. of the filtrate, the total acidity of which has been found, until three-fourths have been driven off. All the volatile acids will pass off and be found in the distillate. The remainder will contain the lactic and hydrochloric acid. The acidity

of the distillate as estimated by titration with decinormal solution of sodium hydrate, using phthalein as an indicator, subtracted from the total acidity of the filtrate, will give the amount of lactic and hydrochloric acid together. From which, if you subtract the amount of hydrochloric acid, the remainder must be the quantity of lactic. If the amount of acidity found by subtracting the acidity of the distillate from the total acidity of the filtrate corresponds to the amount of hydrochloric acid found, then lactic acid is absent. By this method we learn incidentally the amount of volatile acids.

5. Acetic Acid. The presence of this acid may be demonstrated by exactly neutralising the filtrate with soda and treating with solution of perchloride of iron. A red colour will be produced. In practice one usually relies upon its characteristic smell for its detection.

6. Butyric Acid. The tests for this are not at all satisfactory, and in clinical work the sense of smell should be relied upon for its detection, as in the case of acetic acid.

7. Quantitative test for the amount of acids in the stomach contents.

To avoid repetition we designate the total acidity as A, the amount of free HCl as H, the amount of combined HCl as C, and the amount of organic acids as O. For clinical work we neglect the other factors of gastric acidity. Then

$$A = H + C + O$$

To find A.—We place 10 cc. of the filtrate in a porcelain dish, and add to it a few drops of pheno-

phthalein solution. We fill a burette up to 0· with a decinormal solution of sodium hydrate. We allow this to fall drop by drop into the filtrate, shaking the while. We reach the end of the reaction when the rose colour produced by the neutralisation of the phenophthalein remains on shaking. It is the custom to designate the degree of acidity by the number of cc. of the soda solution required to neutralise 100 cc. of the filtrate. Our result, then, multiplied by 10 will give us A, or the total acidity of the filtrate. The percentage in terms of HCl is obtained by multiplying this by 0·00365.

To find C.—We use for this purpose, as an indicator, a 1 per cent. aqueous solution of alizarin monobromate. When mixed with gastric juice, this reagent assumes a pure violet colour as soon as all the factors of acidity, with the exception of the combined hydrochloric acid, have been neutralised. We place as before 10 cc. of the filtrate in a dish, add to it a few drops of the alizarin and tritrate with the decinormal solution of sodium hydrate. As soon as the characteristic colouration has appeared, we read off the number of cc. used. We multiply this by 10 and subtract the result from the total acidity which we have already obtained. The remainder will be the amount of HCl in combination.

$$A - (H + O) = C$$

To find H.—We estimate this in exactly the same way as we found A, by tritration with decinormal solution of sodium hydrate, but using as an indicator a one-half per cent. alcoholic solution of dimethyl-amido-azo-benzol.

To find O.—We have now only to estimate the amount of organic acid present in the stomach contents. This we do by simply subtracting from the alizarin result—which we remember was (H + 0)—the amount of free HCl which we have just obtained. Thus

$$(H + 0) - H = O$$

8. Test for the products of starch digestion.

An hour after a test breakfast containing the usual quantity of starch, so much of this should have been converted into achrodextrin, maltose and dextrine that the erythrodextrin reaction with iodine should be absent. The presence of erythrodextrin in any quantity will point to hyperchlorhydria, as according to Boas* ·07 per cent. of HCl will check, and ·13 per cent. will arrest the diastatic action of the saliva.

Erythrodextrin strikes a brown colour with Lugol's solution (Iodine gr. 3, Potas. Iod. gr. 6, Water 6 oz.).

9. Test for the presence of Rennin and Rennin zymogen.

Add a few drops of the filtrate to 2 or 3 cc. of milk, and keep it at a temperature of 98° or so Fahrenheit for fifteen minutes. If coagulation takes place within that time, rennin is present; if not, then it is absent. In the normal stomach the rennin is not secreted as such, but as an inactive pro-enzyme, which is converted into the active ferment rennin by the action of the HCl of the gastric juice. In cases where the HCl is deficient we naturally find the rennin absent as well. The

* Boas, "Diagnostic u. Therapie der Magerkrankheiten," p. 19.

zymogen, however, may be present, and it is important sometimes to test for it. Rennin zymogen has not the power of coagulating milk, and we must therefore convert it into rennin before we can discover it. We cannot use HCl for this purpose, as it also can curdle milk. Fortunately we have in calcium chloride a substance which is capable of converting rennin-zymogen into rennin. We add 1 cc. of a 1 per cent. solution of calcium chloride to 5 cc. of the filtrate of the stomach contents, which has been rendered slightly alkaline, if it is not already so. Keep the mixture warm for a few minutes, and then test as before by taking a few drops of this and adding to 2 or 3 cc. of milk. Coagulation after fifteen minutes in the incubator will demonstrate the presence of the rennin zymogen.

For clinical use Mr. Martindale has devised a small portable incubator about the size of a cigarette case, which will be kept at the proper temperature for these experiments by the heat of the body when worn in the upper waistcoat pocket. It consists of a small tin case containing five test tubes of 5 cc. capacity, each with a rubber cork, and is provided with a maximum thermometer. It can also be used instead of a water bath for testing the digestive power of the gastric juice in the manner described in the next paragraph.

10. Estimation of the digestive power of the gastric juice.

Boil an egg hard, cut from the white a thin slice, and from this punch some discs with a cork borer or with the barrel of a steel pen. Place several of these discs in a tube of the pocket incubator, and fill up with the filtrate of the stomach

contents. Replace in the incubator and put into the pocket. After two hours examine with the biuret test.

(*a*) There is no reaction. Neither pepsin nor HCl are present.

(*b*) The white of egg is dissolved and the test gives a violet colour. HCl only is present.

(*c*) The white of egg is dissolved and the reaction with the biuret test is purple red. Both pepsin and HCl are present.

If we know from our previous tests that HCl is

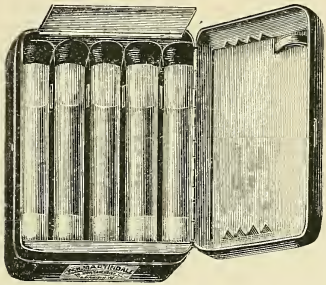

Fig. 11.—Martindale's Pocket Incubator.

not present, we may add a little to the filtrate in the tube. In this case if we get the violet reaction we know that pepsin was absent. If present we shall have the purple red colouration produced.

The violet colour is produced by acid albumen in solution. The red purple colour signifies albumose mixed with peptone, but is sufficiently near for practical purposes. To get the pure rose colour of peptone alone you would have to first throw down the albumose with excess of ammonium sulphate, let stand for twenty-four hours, and

then filter. The biuret test is performed by mixing with an equal bulk of solution of caustic potash and then adding a few drops of a 2 per cent. solution of cupric sulphate.

11. Test for mucus.

The amount of mucus may be roughly estimated by the rapidity of filtration of the stomach contents. When we wish to know at all accurately whether the gastric mucus is in excess, we should search for it in the morning when the stomach is presumably empty. Using a large funnel, we allow the same wash-water to run backwards and forwards several times before we finally syphon it off (see page 91). It is possible, quite apart from its quantity, to ascertain whether the mucus in any given case is normal or whether it is a symptom of gastritis. Normal mucus stains only very faintly with methyl green, and when treated with acetic acid swells up but does not precipitate. *Per contra*, the mucus met with in chronic gastritis after the transformation of the cylindrical epithelium into goblet cells stains intensely with methyl green, and is precipitated by acetic acid.

12. Tests for blood.

It frequently happens that it is necessary to test for the presence of blood in the stomach contents. The test usually advocated, that with guaiacum and ozonic ether, is unreliable unless performed with special precautions, which unfit it for clinical use. The best methods of recognising blood in the stomach contents are—

(*a*) Simple microscopical demonstration of the red corpuscles.

(*b*) The Prussian blue test. Take a little of the sediment from the filter paper through which the

stomach contents have been passing, and place it in a porcelain capsule with a pinch of powdered chlorate of potash. Add a drop of strong HCl and evaporate at a gentle heat. You repeat the addition of the HCl and the subsequent heating until the residue is colourless. You then add a drop of a 1 per cent. solution of ferrocyanide of potassium. If blood be present Prussian blue will be formed. It is needless to remark that neither underdone meat as food nor iron as medicine must have been taken for some hours before this test. The heating should be done slowly and gently, preferably upon a sand bath.

(*c*) As a confirmation test we may manufacture, from the sediment containing blood, hæmin crystals, as suggested originally by Teichmann, and recognise them under the microscope. This well-known test is performed as follows: Evaporate a small quantity of the sediment almost to dryness in a porcelain dish. Place a tiny particle upon a microscopic glass slip, with a little common salt and a drop of glacial acetic acid. Put on a cover-glass and heat over a spirit lamp until bubbles commence to form. If blood be present the characteristic reddish, rhomboidal crystals of hæmin will be seen on microscopical examination. This test has failed in several cases where blood was known to be present. It should not, therefore, be relied upon as proving the absence of blood, but only used as a confirmation test when the Prussian blue test has shown it to be present.

13. Fermentation tests.

In cases of retention of food residues we may derive valuable information from the rapidity of gas formation. We can ascertain this in the

following manner: We finely divide some freshly extracted stomach contents, and fill with it an ordinary Southall's, Down's, or Doremus's ureameter, and stand it in a warm place.

(*a*) In a normal stomach there will be very slight gas formation in several days.

(*b*) Gas formation in a few hours will probably indicate stenosis of the pylorus.

(*c*) Gas formation occurring only after a few

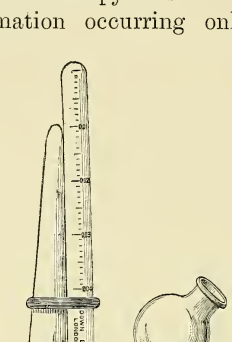

Fig. 12.—Ureameter for use in making the Fermentation Test.

days will denote that there is probably dilatation of the stomach without stenosis.

A complete set of apparatus and reagents for testing the stomach contents in ordinary clinical work should comprise the following items :—

Apparatus.—Nest of glass beakers, nest of test tubes, nest of porcelain evaporating dishes, a few watch glasses, burette and stand, filter and stand, filter papers, Martindale's pocket incubator, test tube stand, conical glasses, glass rods, spirit lamp,

Southall's or Down's ureameter, microscope slips and cover-glasses. To these may be added with advantage a centrifuge. A modern microscope provided with a 6th and an oil immersion 12th is of course assumed to be in the possession of the reader.

Reagents.—Blue litmus paper, congo red paper, benzo-purpurin paper, dimethyl-amido-azo-benzol paper in wide-mouth corked bottles.

One pint of a decinormal solution of sodium hydrate: 10 ounces of methylated ether in a capped ether bottle: 5 ounces each of caustic potash solution of the strength used in ordinary chemical analysis, Fehling's solution and calcium chloride 1 per cent. solution: ½ ounce each of phenophthalein 1 per cent. solution, cupric sulphate 2 per cent. solution, alizarine monobromate 1 per cent. aqueous solution, Lugol's solution, dimethyl-amido-azo-benzol 0·5 per cent. alcoholic solution, methyl green solution, methyl violet solution, dilute acetic acid, glacial acetic acid, ferrocyanide of potassium 1 per cent. solution, neutral ferric-chloride solution: ½ ounce each of strong hydrochloric and nitric acids in capped bottles: ½ ounce each of sodium chloride and powdered potassic chlorate: and 5 ounces of ammonium sulphate.

With this outfit the student will be able to perform any of the tests described in this book.

This set of apparatus and reagents should be collected and kept ready for use in a case or cupboard, as the preparation of them will take some little time.* Many men make unnecessary difficul-

* The above set of apparatus and reagents in a wooden case ready for use is supplied by Martindale, 10, New Cavendish Street, W.

ties for themselves because they do not attempt to procure the solutions until their first case requiring the analysis of the stomach contents presents itself. I very strongly advise that familiarity should be obtained with the different reagents by noting their behaviour with made up solutions of HCl, pepsin, &c., before attempting to test actual pathological material. A few hours devoted to serious study in this direction will amply repay the worker by the acquaintance which he will gain with the technique, and the confidence which he will thereby acquire in the interpretation of the results obtained.

With this end I would suggest the following short course of study :—

In the first place, make up the following dummy solutions upon which to practise.

Hydrochloric acid, 0·3 per cent. solution. This can be made up with sufficient accuracy by adding 8 cc. of strong hydrochloric acid of the specific gravity of 1·20 to 1,000 cc. of water.

Lactic acid solution, 0·8 per cent.

Acetic acid, 1 per cent.

Artificial gastric juice.—Take 500 cc. of your HCl solution, add to it 1 gramme of commercial pepsin, 1 teaspoonful of essence of rennet, and a trace of lactic acid.

Artificial stomach contents, No. 1.—This is an imitation of the contents of the stomach after an Ewald test breakfast. Take 2 ounces of stale breadcrumb. Soak in hot water and drain. Mash up with 20 grains of taka-diastase powder. Keep in a warm place for ten minutes, then add to 500 cc. of artificial gastric juice.

Artificial stomach contents, No. 2.—This will

imitate the results of the test dinner. Take an ounce of underdone steak, pass it through a mincing machine, add the white of an egg, one ounce of bread prepared as in the last section, and place them all in 500 cc. of artificial gastric juice. Keep the mixture warm over a water bath or near the fire for half an hour. Then add a teaspoonful of Denayer's or any other commercial peptone, which consist largely of albumose.

Artificial stomach contents, No. 3.—We here attempt to imitate the condition we often find in malignant disease. Take 2 ounces of bread prepared with taka-diastase, half a dram of some dessicated blood preparation, such as Parke Davis's Sanguis bovinus exsiccatus, and 500 cc. of the lactic acid solution.

Artificial stomach contents, No. 4.—This will represent the condition of the contents of a stomach after what is known as "a good dinner," such as a Masonic banquet, and affords excellent practice in the analysis of vomit. We compound it as follows. Two ounces of underdone meat put through a mincing machine, 1 ounce of milk, half a teaspoonful of extract of rennet, 1 dram of commercial pepsin, 3 drams of cream, 3 ounces of bread treated with taka-diastase, 20 minims of strong lactic acid, 2 teaspoonsful of peptone (Denayer's), 1 ounce of mashed potato, 1 ounce of boiled green vegetable put through a sieve, 3 ounces of claret, 1 dram of strong acetic acid, ½ ounce of butter, 2 ounces of strong coffee, 20 grains of salt, 40 grains of sugar, and hydrochloric acid solution up to 500 cc. Mix these ingredients all together and keep in a warm place for an hour. It will then be ready for analysis.

Lesson 1.—Note the behaviour of the hydrochloric acid solution with—

(*a*) Litmus paper, congo red, methyl violet, benzo-purpurin, alizarin, and dimethyl-amido-azobenzol.

(*b*) Contrast the results obtained with those produced by lactic acid and acetic acid respectively with the same reagents.

(*c*) Mix equal parts of the hydrochloric and lactic acid solutions and try the same tests.

(*d*) Add acetic acid to the mixture and try the same tests again.

(*e*) Now try all these tests over again, having added a small quantity of peptone to the respective solutions.

When perfect familiarity has been obtained with these tests you may make your first attempt at quantitative analysis.

Lesson 2.—Take your 0·3 per cent. solution of hydrochloric acid and tritrate it with the decinormal solution of sodium hydrate, using phenophthalein as an indicator. If you perform the test properly your result should tally with the known percentage. Now get some friend to mix you a solution of hydrochloric acid of a percentage known to himself but not to you. Attempt to find out the percentage by the preceding method and repeat the tests until your results tally with the actual composition of the liquid.

Lesson 3.—Take artificial stomach contents No. 1. Estimate the free hydrochloric acid, the total acidity, test for rennin, erythrodextrin, and apply Fehling's and the biuret test.

Lesson 4.—Take artificial stomach contents Nos. 2 and 3. Test quantitatively for free and

combined acids, erythrodextrin, peptone, rennin, and blood. Compare carefully the behaviour of the two solutions.

Lesson 5.—Make a complete analysis of stomach contents No. 4, attempting to prove the presence chemically or microscopically of all its constituents.

CHAPTER V

ACCESSORY MEANS OF DIAGNOSIS

McCaskey's cardiameter—Gastro-diaphany—Röntgen rays.

In this chapter we study some of the accessory means of diagnosis, which, although not in common use, may on occasion help us very much in the elucidation of the clinical problems which come to us for solution.

McCaskey's Cardiameter.

This is a very ingenious piece of apparatus for locating the cardiac orifice of the stomach, and deserves an extended use. In passing a tube it is a most important thing to ascertain whether it has entered the stomach or not. And this is especially the case when we wish to ensure that the end of our tube should only pass a little way beyond the cardia and not project far into the cavity of the stomach, as, for instance, when we are applying the intragastric spray. Until the invention of the cardiameter of Dr. McCaskey, we had no means of accomplishing this. The distance of the cardiac orifice from the teeth will vary in different individuals, and although we may form an idea by measuring from the teeth to the

side of the spinous process of the dorsal vertebra, by a tape (see page 7), the result obtained will be only approximate. With the cardiameter we are enabled to measure the distance of the cardia in each patient once for all. We can then have an absolute knowledge of the position of the eye of the stomach tube whenever we pass it. The apparatus consists of a stomach tube open at each end. To the proximal extremity is attached a rubber bulb (A) : to the distal end a small bag of very thin rubber (C). The whole apparatus is so

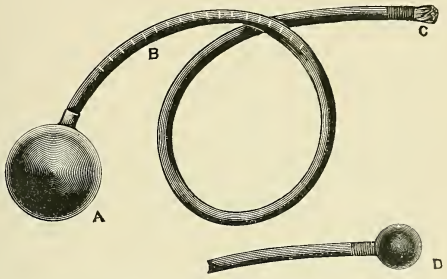

Fig. 13.—McCaskey's Cardiameter.

adjusted that when the rubber bulb is in its natural condition of expansion the rubber bag of the other end of the tube is empty of air and collapsed, as at C. If the rubber bulb be compressed the bag will expand, as at D. In order that it may be possible to demonstrate the position of the distal end of the tube by means of the X-rays, there is a small piece of metal tube inserted. The tube is graduated in centimetres commencing at the distal end.

Method of Using the Cardiameter.—Prepare the cardiameter for passing by tucking the collapsed

rubber bag into the open end of the tube or wrapping it round, whichever is the easiest. Lubricate the tube well with glycerine jelly. Pass it exactly in the same manner as a stomach tube. Now squeeze the bulb with the right hand, and keeping it compressed, try gently to draw out the tube. When the inflated bag reaches the cardiac orifice of the stomach it will be arrested. You now read off the division on the scale which is opposite the incisor teeth, allow the bulb in your right hand to relax, and withdraw the apparatus, which will now come out easily. The centimetre mark which you read off will be the distance of the cardia from the incisor teeth.

Gastro Electro-Diaphane.

This is used for the transillumination of the stomach and consists essentially of a small 8-volt lamp attached by a suitable mount to the end of

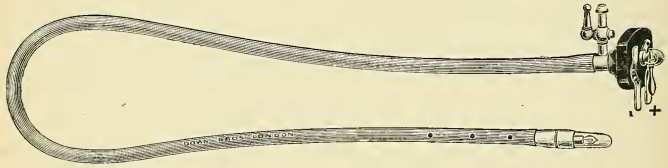

Fig. 14.—Kuttner's Gastro-diaphane.

a red rubber stomach tube. Several patterns can be procured, but the original instrument of Einhorn will answer every purpose. It is quite unnecessary to have a water-cooled instrument, as the electricity should only be turned on for very brief intervals. The one figured above is frequently used, and possesses the advantage that water can be injected through it into the stomach

after it has been passed. This obviates the necessity of making the patient drink before the operation.

Technique for the Use of the Gastro-Diaphane.—After the patient has swallowed a litre of water, the instrument is introduced into the stomach of the patient in exactly the same manner as the stomach tube. The current is now turned on by the switch on the instrument, and the area of the stomach will be shown as an illuminated zone

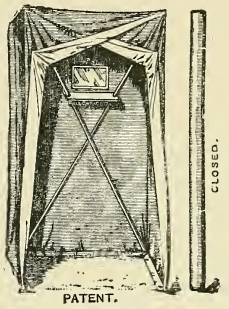

Fig. 15.—X Portable Dark-room.

upon the front of the abdomen. Any tumour upon the anterior wall of the stomach will show up as a dark patch. At least, theoretically, such should be the case. As a matter of fact, there are certain fallacies and limitations which must be kept in mind in order that a correct interpretation may be made of what is seen.

Of course it is necessary that the examination be conducted in a darkened room. As it is sometimes inconvenient to darken your whole consulting-room, in fact, sometimes quite out of the question in modern-built houses, one may use with

advantage and perfect efficiency one of the portable photographic tents or dark-rooms, which can readily be procured at any of the dealers. The one I use personally is known as the X portable dark room, so named from the arrangement of the supporting framework. It is portable, uncomplicated, allows plenty of room for both operator and patient, and is cheap, costing only 21s.

The little lamp will be worked in one of the following manners, according to the electrical supply which is available.

1. If on the alternating circuit the E.M.F. is reduced by means of a Woakes' transformer, or by means of one or two incandescent lamps introduced into the circuit.

2. If on the continuous current a rheostat may be used, or incandescent lamps may be introduced into the circuit, or the current may be used to charge a small accumulator. This last method is especially to be commended, as a small accumulator can be easily carried to the patient's house, if an examination should be required to be made there, and can be taken into the portable dark room aforesaid, thus avoiding long connecting wires. Several of the small accumulators of ½ ampere-hour capacity used in the ballet do very well, and can be placed side by side in a small box and connected up in series.

3. Where the electric house current is not available, either small accumulators may be used, which can be sent out to be charged or charged at home by means of such a cell as the Edison-Lalande or the boron, or, as the lamp will be only used a few seconds at a time, primary dry cells can quite well be made use of. I have found the

following routine method of arranging my apparatus the best: First of all connect the diaphane with the source of electricity by the conducting cords supplied with it, turn on the electricity and regulate it by a rheostat, which should be always included in the circuit, until the lamp burns with the greatest degree of brilliancy consistent with the integrity of the filament. Disconnect the wires from the diaphane (there is a sliding connection) and place the battery, accumulator or transformer on a small table at the immediate right of the spot where the patient will eventually stand. If using a portable photographic dark-room, these may be placed upon a triangular shelf in the posterior right-hand corner. Now give the patient, whose stomach should be empty, a large glass of water to drink unless you are using Kuttner's apparatus, and pass the diaphane in exactly the same manner as an ordinary stomach tube (see page 12). If you are using a portable dark-room you do this outside, the patient sitting in a chair. If you have darkened the whole room you must have artificial light turned on whilst you pass the instrument. Having done this, cause the patient to close his lips upon the tube and also to hold it close to his mouth with his left hand, otherwise it might slip bodily into the stomach. If you are using Kuttner's tube you will now inject 10 ounces of water through it into the stomach. Now, either turn out the light or take the patient into the dark-room, connect the apparatus with the source of electricity, and either close the curtains of the dark-room or turn out the light respectively. The patient holds the tube with his left hand at the left side of his mouth, whilst with

his right he holds up the lower part of his vest so as to expose the abdomen. The operator controls the switch of the apparatus with his left hand, whilst his right is free to mark out upon the surface of the abdomen with a dermographic pencil the outline of the area of illumination.

In order to get good results it is not necessary that the stomach should have been previously washed out, but it is essential that it should contain from one to one and a half litres of water at the time of the examination. This is most conveniently introduced through Kuttner's diaphane after it has been passed.

The illuminated area caused by the stomach may be obscured by liver, intestine containing fœces, or by tumours. The lower part only of a normal stomach should be translucent. When the whole stomach is illuminated gastroptosis is most likely present. In this case the illuminated area will not move with respiration. In dilatation of the stomach the upper border of the stomach is not seen and respiratory movements are present.

When a gastric tumour occupies the lesser curvature of the stomach a dark spot should appear at the upper part of the illuminated area. A dark spot at the lower part of the area would indicate a tumour of the greater curvature and at the right one of the pylorus.

In drawing deductions from gastro-diaphany allowance must be made for the fact that light radiates beyond the limits of the stomach, making especially the part occupied by the pylorus appear larger than is really the case.

Examination of the Stomach by the Aid of the X-Rays.

In some persons the outline of the stomach can be clearly seen as a clear area below the shadow produced by the heart. Under such circumstances any tumour situated in the body or at the pyloric orifice can be easily made out. Tumours at the cardiac end are hidden by the heart and cannot be differentiated from it unless of large size. In a case of cancer of the cardia which I had an opportunity of recently examining the outline of the stomach was quite distinct and it could be seen quite empty and free from any tumour, the growth being completely hidden. In other cases the outline of the stomach cannot be made out, and we must either inflate it or introduce into it something capable of casting a more distinct shadow. For the latter purpose we may use—

Turck's Gyromele. — This apparatus is quite efficient for this purpose. If we introduce it into the stomach and whilst gently rotating it push it down so that to the extent of 70 or 80 cm. it will glide along the greater curvature of the stomach and on reaching the pylorus in many cases curve itself upwards. When shown upon the fluorescent screen by the X-rays it will define pretty accurately the lower margin of the stomach and the position of the pylorus.

McCaskey's Cardiameter.—The metal end of this instrument may usually be seen, and will mark the position of the cardiac orifice of the stomach.

The disadvantages attending the attempt to

locate the stomach by the projection upon the fluorescent screen of metallic instruments are twofold. In the first place many patients cannot swallow a stomach tube, or will not allow it to be passed, and secondly, we are never sure that the lower margin of the stomach has not been pushed down by the instrument, and the stomach in consequence made to apparently occupy a lower position than in reality. Various attempts have been made to introduce into the stomach substances opaque to the X-rays, such as capsules of bismuth, which would subsequently pass along the alimentary canal. Gelatine dissolves so quickly that there is hardly time to make an adequate observation. In my own practice I get over this difficulty in a very simple manner.

Author's Keratin Coated Capsules.—I fill Platen's capsules of the largest size with carbonate of bismuth and coat them with keratin, a substance insoluble in acids but soluble in any alkaline fluid. It is largely used for coating pills which are required to pass through the stomach without solution. On reaching the intestine the alkaline juices there quickly effect the disintegration of the keratin and allow the pills to exercise the local action which was intended. Keratin is made by treating horn shavings with pepsin and dilute HCl. The residue is dissolved in a weak alcoholic solution of ammonia and evaporated to the consistence of mucilage. In order to coat a gelatine capsule with keratin it is necessary to rub it over with cocoa butter. Three coats of the keratin solution are now given, the capsule being allowed to dry between each. I usually give three or four at a time, taking care

to ensure the acidity of the stomach by administering a few ounces of a physiological solution of hydrochloric acid. By means of the X-rays the capsules can be seen resting upon the lower curvature of the stomach, and not only can the position be made out, but also we can in many cases form some sort of idea as to the motility of the stomach from the movements communicated to the capsules. When our observation is completed we have only to neutralise the stomach contents by the administration of some bicarbonate of soda in solution to ensure the solution of the capsule and the liberation of the contained bismuth. We may conveniently make use of the gas which will be liberated in the stomach to further determine the size and position of the stomach (see page 21) and thus check the conclusions which we have arrived at by means of the X-rays.

Author's Chain Cachet.—The apparatus consists of a piece of fine silver chain, about two inches in length, attached to the extremity of a stout piece of silk. The chain is coiled up inside an ordinary wafer cachet. This, of course, is done before the two halves are connected together. The whole when wetted can be swallowed with no more difficulty than an ordinary cachet containing a drug. Once inside the stomach, the wafer is quickly dissolved, and the chain will lie upon the greater curvature of the stomach. The observation is then made in the usual way and the chain pulled up by means of the silk thread.

Rosenfeld's Tube Containing Shot.—This consists of a rubber tube closed at its lower end and containing 150 grammes of leaden shot. The last

four inches are perforated with fine holes. This is introduced into the stomach and an outline of the body obtained upon the screen. The tube filled with shot will show up well and will point out the lower border of the stomach. Air is then blown into the stomach through the tube and a spot of light will appear which gradually increases in size. This will show the exact size and position of the stomach.

In using the X-rays for locating the stomach, there are certain points which must be attended to if we wish for success.

1. The patient must hold his breath whilst we are making our observation, otherwise the respiratory movements will cause a blurring of the shadow.

2. To avoid distortion of the anatomical details, we must square the fluoroscope and the tissues with the axis of the rays at a correct right angle.

CHAPTER VI

LAVAGE OF THE STOMACH

Method with funnel—The author's funnel, stand and connecting mount—The author's graduated jugs—Technique of lavage with the funnel—Diagnostic lavage—Hemmeter's curettage of the stomach—Leube-Rosenthal apparatus—The author's three-way tap apparatus.

Lavage of the stomach may be diagnostic or therapeutic. In the former case we wash out the organ with the object of securing small pieces of the gastric mucosa, or of ascertaining whether any food *débris* may be present: in the latter, we relieve the organ by removing its contents when from various causes it is unable to empty itself, we remove mucus or colonies of micro-organisms from its walls, or we act directly upon the stomach itself. By employing water of a high or low temperature either separately or in immediate alternation, we can exercise a stimulating effect upon the peripheral nerve endings in the stomach walls, and by making use of various medicinal substances dissolved in the washing water, we can make sedative, stimulant, astringent or antiseptic applications to the mucous membrane. Moreover, it has been abundantly proved that lavage can be performed in such a manner as to act as a kind of massage to the stomach. To

produce this effect, and for the application of medicated solutions, the modification known as the intragastric shampoo (see page 107) is to be preferred to ordinary lavage.

Lavage may be performed in two distinct methods :—

1. With a simple funnel.

2. By a pump arrangement such as a Higginson syringe, or by means of a douche-can raised above the level of the patient, as in Rosenthal's apparatus and my own three-way tap.

These methods have advantages and disadvantages, and have each their appropriate sphere of usefulness.

Lavage with the Funnel.—The apparatus required will be a proper stomach tube, two feet of rubber tubing, a connecting mount for joining the two together, a proper funnel, and it is a convenience but not an absolute necessity to have a funnel stand.

The stomach tube.—The selection of the tube has been already fully discussed upon page 3. The most important points to bear in mind are that the tube should, if possible, possess two eyes, one large and one small, at the same level, and that the eyes should be bevelled and not possess sharp edges. An instrument with a terminal eye and one at the side near the tip will answer very well, also any pattern which has several eyes near each other. Of course, one can make shift with the ordinary pattern as procurable in England, with two eyes several inches apart, but the others are preferable if they can possibly be obtained. If your instrument has eyes with sharp edges, you can bevel them yourself by heating for a moment

over the flame of a spirit lamp, just letting the tip of the flame play upon the edge of the eye and then immediately rubbing with a piece of cotton rag.

The connecting mount.—One of the first problems which will confront the worker is to procure a practicable connection between the stomach tube and the rest of the apparatus. Theoretically an ideal connection should possess the following qualities :—

1. It must be conical at one end and cylindrical at the other. The conical end is for insertion into the end of the stomach tube to enable it to be withdrawn and replaced with ease during the operation of lavage, if necessary. The cylindrical end is inserted into the rubber tube connecting the rest of apparatus, and may conveniently be wired in.

2. The mount must be constructed of the thinnest metal consistent with strength.

3. The lumen of the ends must be equal to that of the stomach tube and rubber tube respectively. These tubes will easily stretch to pass over the mount. We shall thus have a connection which does not diminish in the slightest the lumen of the canal through which the fluid has to pass, and enables us to take advantage to the utmost of the calibre of the stomach tube we are using. After considerable trouble I have had manufactured for me mounts according to this specification, which are shown in Fig. 16, which represents them two-thirds of the actual size.

It is unnecessary to have the connecting mount of glass, as when using the funnel, the liquid can be seen escaping from the end, and in the other forms of apparatus it is better to have a

small piece of glass tube permanently inserted in the rubber tube which carries the mount. In the Rosenthal apparatus the working can be, of course, watched through the tube. Glass is very unsuitable for a connecting mount, insomuch as, to secure the same calibre as the stomach tube, it is necessary to use a glass tube of such a diameter that it is impossible to insert it and withdraw it as quickly from the stomach tube as is often necessary in practice.

The rubber tube.—This should be of the best red rubber with moderately thick walls.

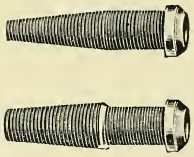

FIG. 16.—Author's connecting Mount for Stomach Tube (two-thirds size).

The funnel.—The ordinary glass funnel, such as is used for filtering purposes, is quite unsuitable for washing the stomach.

(*a*) If selected of such a size that its stem shall easily enter the rubber tube, its capacity will be too small for practical purposes; whilst if a suitable capacity is selected, its stem will not enter the tube.

(*b*) Owing to the thickness of its walls the calibre of the stem will be much less than that of the rest of the tubing, and thus materially reduce the efficiency of the outfit. To obviate these disadvantages, a special funnel for washing out the stomach has been constructed for me of a more rational shape.

In default of this special funnel a tolerable substitute may be made from an ordinary bottle. Procure one of white glass, of the capacity of one quart, remove the bottom by cutting round with a diamond, and grind the cut edge smooth on a stone, using plenty of water. In the neck insert a perforated cork, and pass through this a short piece of glass tube, the calibre of which corresponds

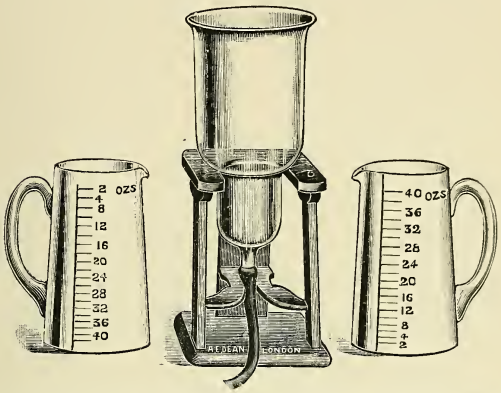

FIG. 17.—The Author's Funnel, for washing out the Stomach, with Funnel Stand and Pair of Graduated Jugs.

with that of the rubber tube into which it is to be inserted.

The funnel stand.—This is made of wood, and stands upon the table near the patient. It will be found a great convenience, as the funnel can rest in it at any part of the process and thus leave both hands of the operator free. It is especially useful when the patient is performing lavage upon himself without assistance.

One must also provide a couple of glass jugs

holding 40 ounces each. One is graduated, with the numbers starting near the top. This is to hold the liquid which is to be used for lavage. The other is graduated in the reverse manner, the numbers starting from the bottom. Into this we syphon the liquid from the stomach. We can thus ascertain at any moment that all the fluid which we introduce into the stomach is again extracted, as in both jugs the level of the fluid should be at the same number of ounces on the scale. We should have two or three of each kind, as not only is a considerable amount of water often required, but in cases where the lavage is to be terminated by the application of a medicated solution, this can be kept ready prepared in one of the jugs.

In order to avoid cooling, the jugs of water which are to be used, should stand in a circular deep pan of earthenware full of water at the body temperature.

Technique of Lavage with the Funnel.—Everything being in readiness, the tubes connected with each other and with the funnel which rests in its stand on the table, the operator proceeds to pass the stomach tube in the manner described on page 12.

There are now two distincts methods of proceeding.

First method.—The funnel being held slightly higher than the patient's head, the water is poured slowly into it until it has been judged that a sufficient quantity has entered the stomach. At this point, just before the last funnelful has emptied itself, compress the tube just below the funnel by nipping it in the crook of the

little finger. If this be properly done, the water will be held fast, and the whole tubing from the orifice of the funnel will remain full of liquid. If the funnel be now lowered over the graduated jug syphonic action will be set up, and the stomach will empty itself. The entire process can then be repeated until the washing water comes away clear.

Second method.—The preceding method must never be used in cases of muscular weakness of the stomach, as the weight of water may aggravate the disease. In these cases each funnelful of water must be evacuated before the next is introduced. The funnel is held level with the mouth of the patient and filled with water. It is then slowly raised, and its contents will pass into the stomach of the patient. However, if just before it is quite empty it be quickly lowered as far as possible, still keeping it in a vertical position, it will fill itself again by syphonic action, and can now be emptied into the graduated jug standing upon the table. It is of the utmost importance not to leave any water in the stomach in cases of myasthenia gastrica, and by this method, with the funnel and the graduated jugs we are able to measure all we put in and all that we take out.

This second method of washing out the stomach is especially useful when it is desired to ascertain whether exfoliated fragments of mucous membrane are present in the stomach, such as we so frequently meet with in gastric erosions.

Einhorn * first drew attention to the fact that small portions of mucous membrane could often

* *Med. Record*, June 23, 1894.

be found in the wash water of patients suffering from erosions or small superficial ulcers of the stomach. It is well, therefore, as a routine to examine especially for these exfoliated bits of mucous membrane in all patients who present the symptoms of erosions in the stomach: these symptoms being, according to this author, pain immediately after food, emaciation, and lassitude after meals.

The technique of obtaining these fragments is to perform lavage with the funnel before breakfast, letting the same water flow backwards and forwards between the stomach and funnel several times. You do this by alternately raising and lowering the funnel. The last time you lower it you allow the stomach to quite empty itself into the graduated jug. You repeat this operation a few times with fresh quantities of water. Pour the wash water, a few ounces at a time, into a large, flat, black papier-maché tray, such as is used in photography. The fragments will show up against the black background as small pinkish-white little fragments of tissue. These if of small size may be removed by sucking them up one by one into such a pipette as is used for filling fountain pens. They are then placed in a small glass beaker for further examination. The best method of preparing these fragments for microscopical examination is to wash in normal salt solution, harden in corrosive sublimate, embed in celloidin, cut sections and stain and mount in the usual manner.

More recently Hemmeter * has elaborated the

* "Histologic Studies relating to the early Diagnosis of Carcinoma of the Stomach," *Philadelphia Med. Journal*, February 2, 1900, p. 279.

idea and advises what is practically curetting the stomach to extract pieces of mucous membrane, with the especial object of diagnosing carcinoma in an early stage. The procedure is accomplished painlessly and with perfect safety by introducing into the stomach a tube with a sharp-edged, unbevelled eye, such as the stomach tube still sold and used in England. The tube, when introduced, will strike about the middle of the greater curvature of the stomach and glide towards the pylorus. If on its passage it be gently rotated, some pieces of mucous membrane will usually be detached. The diagnostic significance of fragments of mucosa rests upon the relative number of border or acid cells which are present and the occurrence of pathological mitosis.

Various attempts have been made from time to time to improve upon the simple arrangment of funnel and tube which was devised by Somervail as far back as 1823, its great disadvantage being that syphonic action has to be started afresh after each introduction of fluid into the stomach. The most notable improvement was the—

Leube-Rosenthal apparatus, which was constructed in the following manner. The essential part of the apparatus was a glass **Y**-piece. One arm of this was connected with a rubber tube proceeding from a douche-can hung some little distance above the head of the patient. The second limb carried a tube which passed to a receptacle placed upon the floor, and the remaining one was connected with the stomach-tube. Upon the first and second tubes were placed metal taps or clips by which the flow through them could be controlled. The apparatus was used

in the following manner. The douche-can having been filled with water and the stomach tube having been introduced into the patient, the tap on the rubber tube proceeding from the douche-can was opened. Water thus passed into the

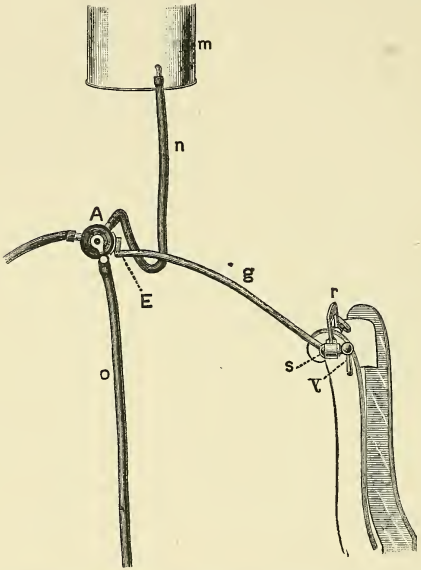

Fig. 18.—Author's Three-way Tap Apparatus for Lavage, original model with Clamp and Arm for fixing to Chair Back.

stomach. Then, whilst the water was still passing, the tap on the tube to the receptacle was opened and the end of the stomach tube was nipped with the fingers of the left hand. The stream was thus diverted into the tube

passing to the receptacle on the floor. If the tap controlling the tube coming from the douche-can were now shut, syphonic action would be established when the pressure on the stomach tube was relaxed, and the stomach would empty itself. This apparatus is very admirable, and in the hands of a practised operator gives the best results. It is, however, too complicated for use in general practice, as almost the skill of a prestidigitator is required to properly manipulate the taps. Retaining the main features of the apparatus, I have attempted, and I hope not unsuccessfully, to provide a mechanism which will perform the necessary concerted movements automatically.

Author's Three-way Tap Apparatus.—The most important part of my apparatus is a three-way tap of special construction which is substituted for the glass **Y**-piece. This is shown in Fig. 19, which is slightly smaller than the original, the diameter of the actual tap being two inches and that of the tube seven-eighths of an inch. The tap is seen to consist of a circular body of vulcanite carrying three tubes, A, B, and C, to be connected respectively with the douche-can, the stomach tube, and the receptacle upon the floor. The tap is turned on and off by the handle D, in the manner to be presently described. E is a socket screwed on to the side of the tap and is designed to receive the end of a jointed arm by which the tap can conveniently be held in a proper position with reference to the patient.

In Fig. 19*a* the tap is shown taken to pieces in order to demonstrate its internal construction. The body of the tap is seen to consist of a ring of vulcanite F, carrying at equal distances

the tubes A, B, and C. The moving part of the tap consists of a vulcanite plug G, carrying at

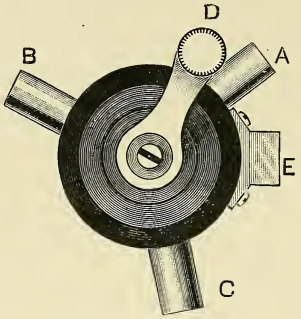

Fig. 19.—Three-way Tap.

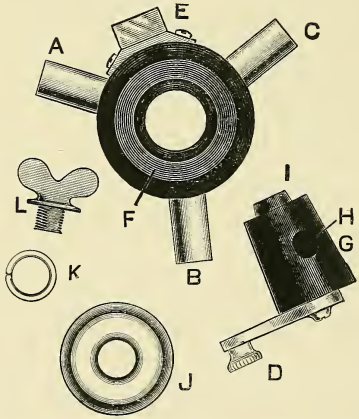

Fig. 19*a*.—Three-way Tap, details. I, the shoulder. J, the washer, and K, the split ring, which fit on to I, and are fixed by L, the screw.

one extremity the handle D, by which rotation is communicated to it, and at the other a shoulder,

I, to project through the centre of the washer J. The plug C is conical and is perforated with holes in such a manner as to produce the results shown in Fig. 20.

In assembling the tap the centre G is first placed in the hollow body. The washer J is fitted upon the shoulder I. Over this is placed the split ring K, and finally the winged screw L, entering the centre of the core, keeps the whole in position. The split ring, K, is an essential part of the apparatus. It is constructed of steel springs in such a manner that its portions stand away from each other. When compressed by the screw L it keeps the parts of the tap so well together that the joint is water-tight, at the same time allowing a very smooth and easy movement. After having been used, the tap can be at once taken apart for sterilisation by unscrewing L. This screw is purposely made "winged" in order that it may be removed by hand without requiring the aid of any tool.

Fig. 18 shows how the apparatus is arranged when using it upon a patient. The tap is here shown at A with its three tubes connected up by rubber tubes to the douche-can m, to the stomach tube by the tube p, and to the pail by the tube o. The tap itself is attached by means of the socket E, already described, to an arm g, which is attached to the top of a chair by means of clamp r. Movement in any direction is provided by a ball and socket joint s, which may be fixed by the screw y. This arm is found in practice to be a great advantage, as it holds the tap steady at a convenient point in front of the patient in such a manner that it can be

manipulated with one hand, the other one being free to hold the stomach tube in position. Otherwise the tap would have to be held in one hand whilst it was manipulated with the other.

Fig. 20 shows the effect of rotation of the handle of the tap upon the flow of liquid through it. When the handle D is in the position shown in (*a*) the flow is between the tubes A and B. When in the position shown at (*b*) between the tubes A and C. And when at (*c*) between B and C. Whence it follows that the tube A being connected with the douche-can, the tube B with the stomach

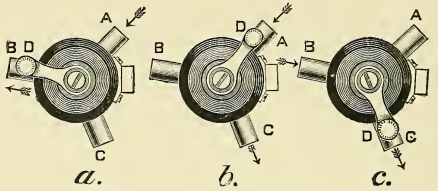

Fig. 20.—Three-way Tap, showing entrance and exit in different positions of D.

tube, and the tube C with the pail or receptacle on the floor, when the handle is in the position (*a*), fluid will be passing from the douche-can into the stomach of the patient. When at (*b*) the stomach tube will be cut off, but will remain full of fluid, and the water from the douche-can will be passing down and filling the tube C which leads to the pail. If now the handle is moved into the third position as shown at (*c*) the douche-can will be cut off and the stomach tube put in communication with C, and as they are at this moment both full of fluid, syphonic action will be set up, and the stomach will be rapidly emptied. When this has

once taken place the handle will not again require to be moved into the position at (*b*), as the tube leading from C will never again become empty.

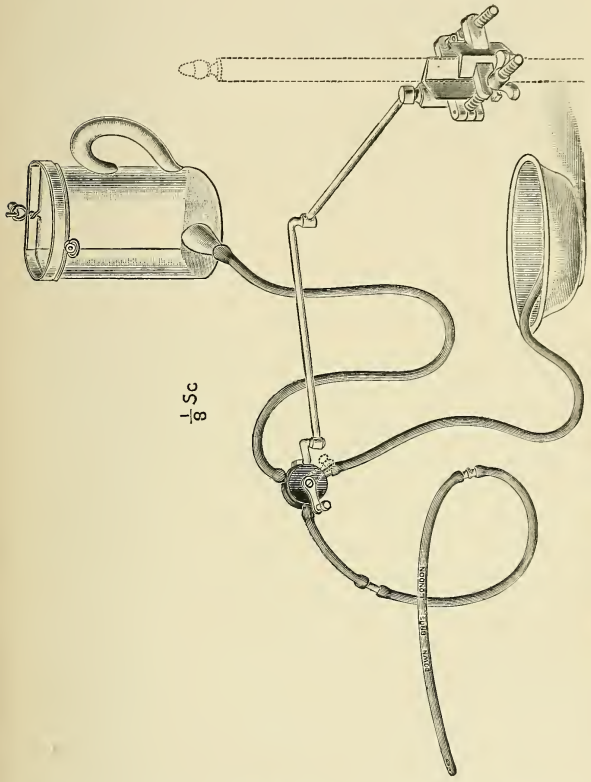

Fig. 21.—The Author's Three-way Tap Apparatus for washing out the Stomach. Latest pattern for attaching to Bedpost.

It will then be found that by moving the handle D successively into the positions at (*a*) and (*c*) the stomach can be filled and emptied as many times as desired.

The apparatus has been recently further improved by the addition of a jointed arm and a special clamp designed for attachment to one of the upright pillars of a bedstead. The tap can thus be swung in front of the mouth of a patient who is in bed and retained in this position, leaving both the hands of the operator at liberty. If the patient is well enough to sit up, the apparatus may be attached to one of the pillars at the foot of the bed, and the can sit in front of the foot of it.

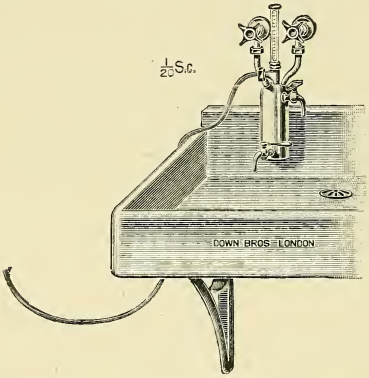

FIG. 22.—Sink with double Tap for hot and cold Water, fitted with Berkefelt Filter.

Suggested arrangement for a Special Operating Room for the diagnosis and treatment of Stomach Affections.—To the specialist a specially fitted room is a great convenience and assistance in getting through his work. The following fittings or their equivalents are suggested, in addition to the apparatus described in this book.

1. *A sink fitted with hot and cold water.*—A good form is shown in Fig. 22.

The hot and cold water supply pass through a Berkefelt filter, from whence they issue by a single

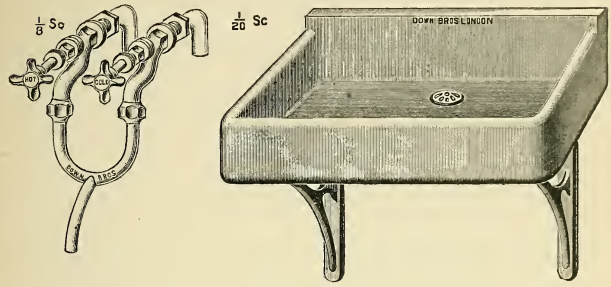

Fig. 23.

tap. It is a point often neglected to use sterile water for washing out the stomach. The Berkefelt filter and the Chamberlain-Pasteur filters were

Fig. 24.—Glass Reservoir.

the only two which have proved efficient in removing typhoid germs from water which was

passed through them, when tested some few years ago.

A cheaper form of sink without filter is shown in Fig. 23, which also shows a convenient double tap for hot and cold water made by the same firm.

2. *A reservoir for holding the water used for lavage.*—This may take the form of a glass vessel holding one or one and a half gallons.

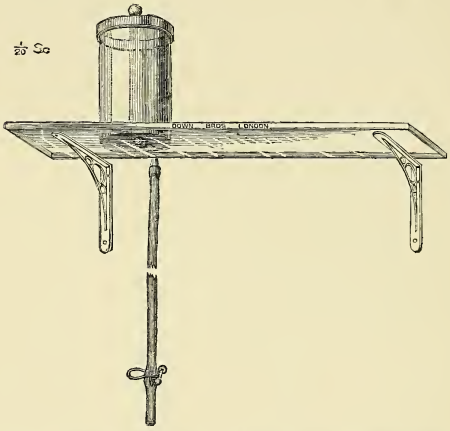

Fig. 25.—Plate Glass Shelf on Brackets carrying Glass Reservoir.

This should be fitted below with a glass cock and provided with a closely fitting lid. For use it should be placed upon a shelf, which may be preferably of glass and attached to the sides of the room by brackets.

Or, if expense be no object, by far the most convenient arrangement is a glass irrigator on a stand which can be adjusted at any required height from six feet downwards. Being on massive

ball bearing rubber-covered castors it can be readily moved into any desired position with respect to the patient.

3. *A pump for filling the irrigator or reservoir without moving them from their positions is a* sine quâ non *if much work of this kind has to be accom-*

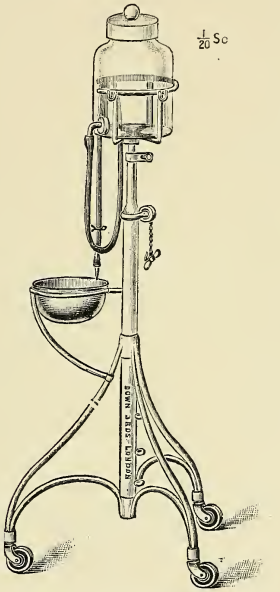

Fig. 26.—Irrigator on Stand.

plished.—A glance at Fig. 27, which represents a reservoir in the act of being filled by such a pump, will render any further description superfluous.

4. *An adjustable couch or chair.*—One of the best is the Yale chair made by the Canton Surgical and Dental Chair Company, Ohio, as the

different inclinations of the body which we can obtain when in it from the horizontal, materially facilitate the diagnosis of gastroptosis and enteroptosis. It should be fitted with the Martin attachment for placing the patient in the knee chest

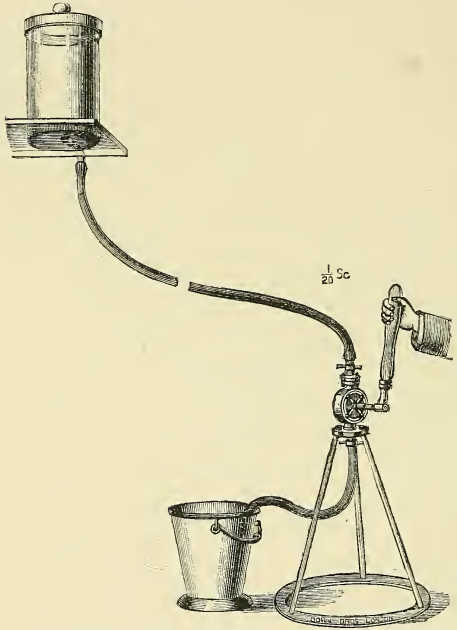

Fig. 27.—Pump for Raising Water into a Reservoir upon a Shelf.

position. In cases where a large outlay is impossible and a special room cannot be devoted to stomach work, makeshift may be made with a small portable sink used in photography.

The swinging tap shown in the illustration can

be attached, by means of a piece of rubber tube, to a two gallon tank fastened to the wall in a corner of the room behind some curtains, and will then do good service. The side flaps shown in the figure will be found extremely useful for standing the funnel stand, or spray apparatus or aspirating bottle during use, and when no longer required can be shut down over the top of the

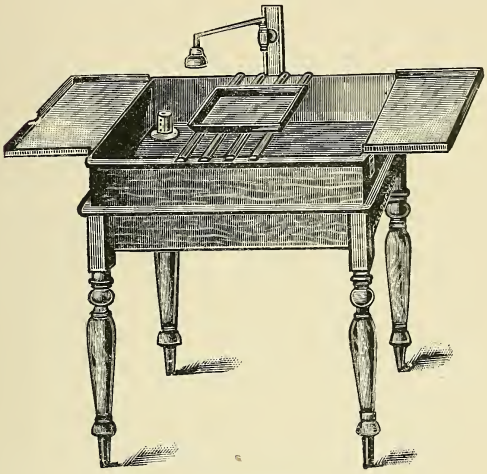

Fig. 28.—Photographic Sink.

sink, converting it into an unobtrusive piece of furniture.

It is also quite easy to make a perfectly efficient irrigator at a very small cost. To do so procure a gallon round bottle and get the bottom cut cleanly out by a glazier. Wire a cork firmly in and pass through its centre a piece of glass tubing. The next thing to do is to make a network of string or

wire over the bottle in order that it may be suspended in an inverted position. Fasten a stout iron bracket to the wall of the room about eight feet from the floor. Attach to the end of the bracket a galvanized iron pulley, and sling up the bottle by a blind cord passing over it. To the glass tube which passes through the cork of the bottle attach four or five feet of rubber tubing ending in a vulcanite tap, and your irrigator is complete. You can lower it to fill it, you can then pull it up to the height you desire. With it you can do just as good work as with the expensive one shown in Fig. 26.

All irrigators or reservoirs used in lavage of the stomach should be graduated in order that the quantity of water introduced into the stomach may be compared with that which returns from it.

CHAPTER VII

SOME INTRAGASTRIC METHODS OF TREATMENT

Intragastric shampoo or needle-douche—Turck's apparatus—The author's apparatus—Technique of the intragastric needle-douche—Affections in which it may be used—Solutions for use with it—Einhorn's intragastric spray—Its action—Indications—Technique for the intragastric spray—Application of nebulised fluids to the interior of the stomach—Technique—Solutions used—Turck's gyromele—Its uses—Technique.

Not the least of the several valuable improvements in stomach medication which we owe to the genius of Fenton B. Turck, of Chicago, is the intragastric needle-douche. This may be described as the application of fine jets of fluid under considerable pressure to the interior of the stomach, and resembles in many respects the shampooing of the head with which we are all familiar. By the use of hot and cold water in alternation, a remarkable tonic effect is produced upon the muscular and secreting structures of the stomach; moreover, adherent mucus is in this way far more easily dislodged than by ordinary lavage.

Any apparatus for giving an intragastric needle-bath must consist of three essential parts — a stomach tube furnished with a suitable perforated extremity, an apparatus for forcing water under

pressure through the aforesaid tube, and a means of keeping the stomach practically empty whilst the operation is going on.

1. The Stomach Tube.

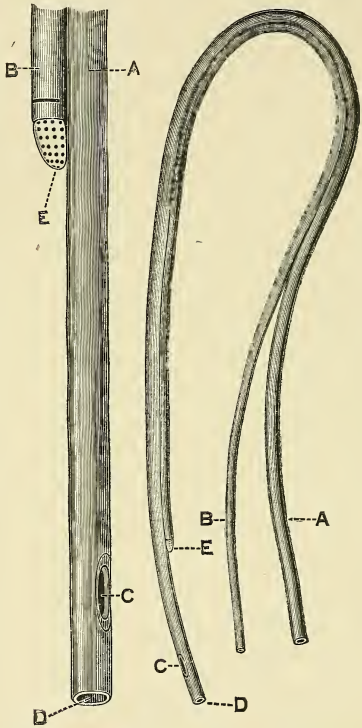

Fig. 29.—Turck's double Tube for intragastric Needle-bath.

Turck's Double Stomach Tube, Fig. 29, consists of an efferent tube A, shown at the left-hand side of the illustration, of its natural size, which is

provided with the terminal eye D, and one at the side C. The afferent tube B is of smaller size and is cemented to A for the greater part of its length. It terminates in a conical perforated bulb shown at E. This bulb is of metal and is provided with a shoulder which enters the end of the rubber tube, to which it is further made fast by a silk thread shown in the sketch as a black line. The tube E is so arranged that it terminates about four inches from the end of A.

The afferent tube B is connected by a suitable mount with the apparatus containing the water under pressure, and the efferent tube A with an exhausting arrangement to be presently described. I would here mention that I wish it to be distinctly understood that I do not claim to have made any improvement in Turck's double tube, which is practically perfect, but figure it here for the sake of those of my readers with whom it may not be familar. It can be procured either from Tiemann, of New York, or from Truax and Greene, Wabash Avenue, Chicago, and in England from Down Bros., 21, St. Thomas' Street, E.C.

2. The Apparatus for forcing Water through the Tube with sufficient Force to cause it to issue in fine jets from the perforated Bulb.

The apparatus used by Turck himself was constructed in the following manner: It consisted essentially of two glass wash-bottles such as are commonly used in a chemical laboratory. They were of thicker glass than usual, and were provided with rubber corks secured by a very ingenious fastening, so that they would not fly out. These stoppers were each perforated with two holes through which passed respectively a long

tube reaching to the bottom of the bottle, and a short one coming only an inch or so below the cork. The short tubes were connected by means of rubber tubes and a Y-piece with a pressure bulb. The long tubes were connected in the same manner with the afferent stomach tube. The efferent stomach tube was connected with an aspirating bottle placed about level with the patient's knees. These bottles being filled with

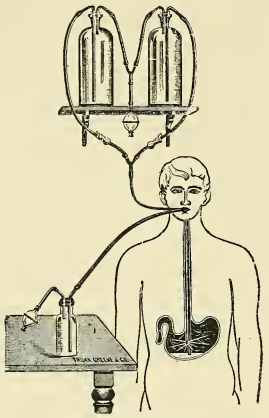

FIG. 30.—Turck's Needle-douche, showing Aspirating Bottle (see p. 43) upon the Table.

hot and cold water respectively, a few pressures of the bulb with the hand would produce sufficient atmospheric pressure in the bottles to cause their contents to issue from the perforated bulb in fine jets. By means of clips on the rubber tubes the contents of either bottle at will could be used.

I have attempted to improve this apparatus in the direction of portability and simplicity.

My instrument was exhibited in the Section of Pharmacology at the Annual Meeting of the British Medical Association held at Portsmouth in 1899.

It consisted of a metal stand holding two glass cylinders, A and B. In each of these is placed a Higginson syringe, C and D, the afferent tubes of which, passing through specially designed spiral supports E and F on the handle G, are attached respectively to the limbs of a Y-piece H. From the third limb of this proceeds a rubber tube I, terminating in a conical nozzle J, of such size as to enter the smaller stomach tube K (the one terminating in the perforated ball). (See Fig. 31.) The handle G is made to shut down into the apparatus for portability, but when in use is maintained at the proper height to keep the tubes of the Higginson syringes straight by a pin L, which enters a hole in the stand. The nozzle J is corrugated so as not to slip out of the rubber tube, and the free tubes of the syringes are best provided with adhesive discs which hold them tight to the bottom of the glass-cylinders.

The central rod of the metal stand is graduated in ounces, so that an idea can be formed as to the amount of fluid which is being introduced into the stomach of the patient.

In using the apparatus, hot and cold water are placed in A and B respectively. The apparatus is placed upon a table at a convenient height opposite to the patient, who sits upright in a chair. The double stomach tube is now passed into the stomach of the patient, and the conical mount J inserted into the proper tube. The other tube is to be connected with the

evacuating apparatus to be presently described. If pressure be now made upon the bulbs C and D alternately, jets of hot and cold water respectively will be forced out into the stomach of the patient. In practice it is convenient to send in one quarter of one cylinder before proceed-

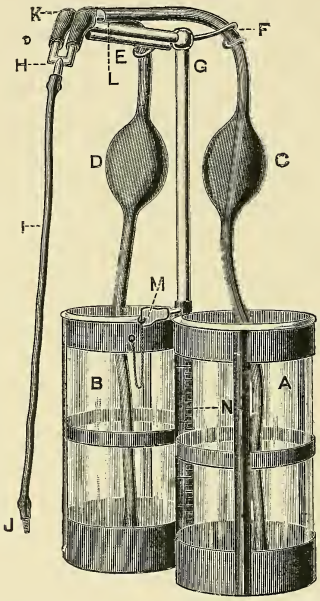

Fig. 31.—Author's Apparatus for Needle-bath. Earliest pattern.

ing to the next. The patient will thus get eight alternations of hot and cold water during the séance. In this form of apparatus clips or valves upon the tubes are quite unnecessary, as from the construction of the Higginson syringe backward

flow is impossible, and the water is only proceeding from the one bulb which is being compressed.

In order that the needle-bath may have efficient access to the walls of the stomach, it is necessary that that viscus be kept nearly empty. This is best accomplished by the compound of aspiration and syphonage suggested by Turck, as shown in Fig. 30. The aspirating bottle should be placed considerably lower than in the illustration. A few compressions of the exhausting bulb will so rarefy the air that the fluid from the stomach will commence to flow into it. After this has once happened the flow will continue by syphonic action until the stomach is empty or the bottle is full. We may, of course, use a simple tube and start the syphonic action in one of the other well-known ways.

Technique of the Intragastric Needle-douche.—

1. To arrange the apparatus and patient.

Pull out the sliding rod which carries the handle and tube clips to its full extent, and fasten in position by the pin M.

Fill the cylinders A and B with hot and cold water respectively. Compress each bulb once or twice so that the tubes may be emptied of air and filled with water. Stand the apparatus thus prepared upon a table near the left-hand front corner. Seat the patient in a chair on the left-hand side of the table, in such a manner that he sits sideways to it. Place the pail or aspirating bottle upon a stool between the patient's feet, and fasten a towel around his neck. Place the Turck's double stomach tube in a basin of warm water.

2. To administer the douche.

Pass the double tube into the stomach of the

patient in the usual way (see page 12). Slip the mount J into the smaller of the two stomach tubes, and press in firmly so that it cannot accidentally be displaced. At the same time introduce into the other one the mount of the long tube leading to the aspirating bottle or pail.

Now commence with the cylinder containing the hot water, and compress the bulb firmly, slowly, yet forcibly, several times. Now leave this and repeat the process with the bulb which controls the cold water in the second cylinder.

Now empty out the water, which you have introduced into the stomach, in the following manner :—

3. To empty the stomach.

The stomach must be kept as empty as possible, in order that the jets of water may reach as much of its interior surface as possible. It is impracticable to keep up continuous syphonic action during the administration of the douche, as, directly the stomach becomes empty, air will enter the tube. It is necessary, therefore, to start syphonic action afresh, as often as you wish to withdraw fluid from the stomach. This is done as follows :—

(*a*) By the Single Tube supplied with the Apparatus.

This, as we have seen, is attached by a glass connecting tube or mount (see page 87) to the larger of the stomach tubes. Its lower end hangs in the pail upon the floor. The patient, or a nurse, takes hold of the end of the stomach tubes close to the mouth and holds them steady. Both hands of the operator are thus at liberty. With the left hand he will pick up the end of the tube from the pail, and with his right he will introduce the nozzle of

an ordinary ball enema which has been squeezed empty of air. If this is allowed to slowly expand the stomach contents will be drawn into the tube, and syphonic action set up. The enema nozzle is now withdrawn, and the stomach allowed to empty itself.

In many cases syphonic action can be set up by a slight straining action on the part of the patient, but this only takes place if the stomach is nearly full of water, and it is not advisable to allow this to happen, or the douche will be ineffective.

(*b*) By means of the Aspirating Bottle.

This is a great convenience, and adds materially to the simplicity of the operation. The rubber tube, instead of passing into a pail, is attached to the free tube of the bottle. A few compressions of the bulb will sufficiently exhaust the air within the bottle as to set up syphonic action.

Note.—Always remove the cork from the aspirating bottle before moving the stomach tube in any way, otherwise you may possibly damage the mucous membrane of the stomach, which may have been sucked into the holes of the efferent tube.

The apparatus has recently been improved with the twofold object of rendering it more portable and of reducing the cost of manufacture. This has been accomplished by doing away with the two glass cylinders and the framework which held them, and attaching the upright carrying the syringes to a metal clip. As may be seen from the accompanying illustration (Fig. 32), the whole apparatus can then be attached to the side of any ordinary mug or jug, which, placed alongside another similar one, will together form an efficient

substitute for the glass cylinders. The makers supply a couple of straight-sided, graduated porcelain vessels of suitable size if required. The graduated glass jugs (Fig. 17) used in lavage will answer admirably. The advantage of the present form of the apparatus is that it can be packed in a little handbag or can be made into a paper parcel of quite moderate dimensions and taken with ease to the patient's house. The affections in which

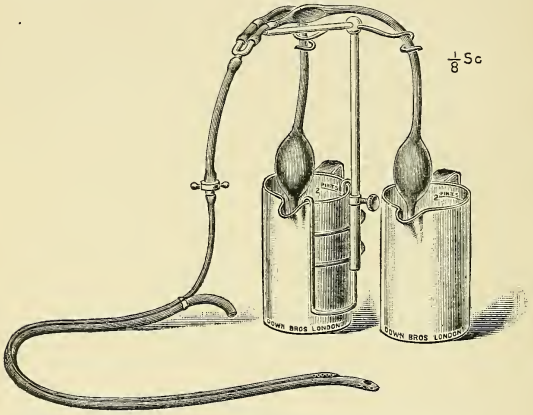

Fig. 32.—Author's Apparatus for Needle-bath. Latest Pattern.

the intragastric needle-bath may be used with advantage are :—

Chronic gastritis.—In this affection of the stomach its chief use is to remove adherent mucus which ordinary lavage leaves untouched. It is a common experience that after even a prolonged lavage with the funnel or three-way tap, the needle-douche or Turck's gyromele will remove quantities of mucus.

Muscular atony of the stomach of the first or second degree. (Stagnation but not retention myasthenia.)—The bombardment of the interior of the stomach by the fine high-pressure needles of water appears to act as a distinct tonic to the muscularis of the stomach, probably by a species of massage, and thus may with advantage supplement electrical methods or replace them when they are unobtainable. In the slight atony accompanying neurasthenia a few applications of the intragastric needle-bath is frequently all the local treatment that is required, in addition to general measures, to effect a complete restoration to health.

Anomalies in the gastric juice.—In these affections the needle-bath often has a very good effect. The rapid alternation of hot and cold water appears to be one of the best tonics which we possess to glandular secreting tissues of the stomach. We may also in cases of this nature employ one of the medicated solutions given below.

The following are the strengths of the solutions most commonly used in the needle-bath for application to the interior of the stomach :—

Common Salt, one teaspoonful to a quart of water.

Infusion of Gentian, one-quarter B.P. strength.

Solution of Tannin, $\frac{1}{2}$ per cent.

Infusion of Quassia, one-quarter B.P. strength.

Sulpho-carbonate of Zinc, one grain to the ounce.

Permanganate of Potash, 1:5,000.

Each of these agents has its own special indications, but it would be beyond the scope of the present work to discuss them. One very important point must be ever kept before us, and that

is not to leave any solution behind in the stomach, since death has resulted from a 2 per cent. solution of boric acid which was allowed to remain there. Always carefully measure the quantity which you make use of in treating the stomach, and do not allow the patient to leave your consulting-room until you have recovered it all again.

Intragastric Spray.

The intragastric spray-producer is one of our most useful pieces of apparatus, and was invented by Einhorn, from whose book we quote the following*:—

"In cases in which it is necessary to apply medicaments of a toxic or irritating character to the gastric mucosa, the risk of poisonous effect can be prevented by the use of the spray, by means of which large surfaces can be covered with a comparatively small amount of fluid.

"In order to make use of the spray in diseases of the stomach the usual spray apparatus has been modified by me in such a way that instead of the hard rubber branch of the apparatus the same branch is made of soft rubber and lengthened. . . . The administration of the spray in gastro-therapeusis is a suitable form for fulfilling the following purposes:—

"1. To disinfect the mucous membrane of the stomach.

"2. To exert an astringent effect.

"3. To produce analgesia in gastralgia of a local character (from ulcer, cicatrix or cancer). . . . The spraying of the stomach has proved very useful in my experience in—

* *Op. cit.* p. 134.

"1. In erosions of the stomach.

"2. In those forms of chronic gastric catarrh which are associated with an abundant amount of mucus.

"3. In cases of hyper-secretion and hyper-acidity."

In order to avoid confusion the reader must bear in mind that the effect of the intragastric spray is quite different from that of the intragastric shampoo or needle-bath. Whilst in the latter we may use several pints of fluid projected against the sides of the interior of the stomach in forcible jets, in the former we probably only use at most one dram; and as this in a finely divided state comes into contact with every part of the mucous membrane which the air reaches, we are enabled to make use of a very strong solution to produce the local effect which we desire without administering to the patient such a dose of the drug in solution as will act injuriously upon his system.

Technique for administering the Intragastric Spray.—In the first place we must make sure that the stomach of the patient is empty. In cases where there is no retention of food residues we use the spray either before breakfast or five or six hours after a meal, as the stomach should presumably be empty. In cases of advanced myasthenia we must perform a preliminary lavage, taking care to completely empty the stomach of the washing-water. In cases where there is a large quantity of adherent mucus we may with advantage use the gyromele as a preliminary measure or give the intragastric needle-douche.

The patient sits upright during the application of the spray. The tube of the spray apparatus,

having been dipped in warm water, is passed into the stomach of the patient until the nozzle is 45 cm. or 18 inches from the teeth. This will in most cases be just within the stomach. The ball of the spray is now compressed and the spraying commenced. As the operation proceeds the tube is gradually pushed further in, little by little, until it has passed to the extent of 50 cm. After the application has been made for two or three minutes the tube is withdrawn and the sitting terminated.

The solutions mostly used for spraying the interior of the stomach are—

(*a*) 1 in 500 solution of nitrate of silver.
(*b*) 1 in 1,000 solution of nitrate of silver.
(*c*) 1 in 250 solution of cocaine.
(*d*) 1 in 1,000 solution of hydrochloric acid.

Application of Nebulised Fluids to the Interior of the Stomach.

The use of nebulised fluids, or the application of medicated solutions in an atomised condition much finer than an ordinary spray, is of quite modern introduction and has hitherto been chiefly used to apply powerful drugs dissolved in an inert oily basis to the respiratory tract. As suggested by Turck they may also be used in a number of gastric conditions and form a useful addition to the armamentarium of the gastro-enterologist. A nebula is different from an ordinary spray and is produced in quite a different manner. Whilst in a spray producer a current of air passing over the orifice of a tube whose lower end is immersed in the liquid, draws up some of it and projects it in a spray or shower of fine drops, in the nebuliser a jet

of the liquid to be atomised is propelled with such force against the side of the vessel which contains it, that it is mechanically broken up into a cloud of such tenuity that it will pass like smoke through a tube three feet or more in length. We are thus enabled to apply powerful medicinal substances to the interior of the stomach through an ordinary stomach tube.

Technique for Nebulising the Interior of the Stomach.—To apply the nebula to the interior of the stomach all that is required is to attach an

Fig. 33.—The Aeriser.

ordinary stomach tube to the nozzle of a Globe Nebuliser, or Aeriser. The tube is passed into the stomach and the nebula administered in exactly the same manner as the intragastric spray described in the last section. It is a good plan in practice to terminate the operation of lavage of the stomach by the application of an analgesic nebula, as we thus send the patient away in a comfortable condition. Having made sure that all the washing water has been extracted from the stomach, we

withdraw the tube until the 45 cm. mark, which should be on all tubes used for intragastric spray or nebula, arrives at the teeth of the patient. Connect it with the aeriser and give an application of menthol of two or three minutes' duration.

We are thus enabled to make use of the tube already in the stomach of the patient. When we are giving a regular application of the nebula it is advantageous to use either a stomach tube, the lower two inches of which are perforated with several holes, or to use the double stomach tube of Turck. The last offers the advantage that we are unable to injuriously distend the stomach, the second tube offering a ready means of escape. If we are using a single tube we must after every few compressions of the bulb disconnect the tube from the nozzle of the aeriser in order to allow the air within the stomach to escape. The formulæ which I mostly use as nebulæ are the following :—

1. Menthol ʒj, Ol. Cinnamomi ʒss, Parolein ad ʒj.
2. Ol. Cinnamomi.
3. Menthol ʒj, Ol. olive ʒj, Parolein ad 1 ʒj.

Oil of cinnamon is a powerful antiseptic and a most useful application to the interior of the stomach.

The Gyromele.

Turck's gyromele is a very ingenious piece of apparatus which is capable of rendering us much valuable assistance in the diagnosis and treatment of diseases of the stomach.

It consists of a flexible steel cable constructed of what is technically known as an over-wound spiral. This is a central core of spring wire round which are closely coiled in different directions

two layers of finer wire. The result is a cable of extreme flexibility, but which will resist torsion to a remarkable degree. It will bend readily, but will not kink, and will communicate rotation in both directions against considerable resistance without twisting. It is, in fact, on a small scale identical with the revolving cable of dental and surgical engines. The end of this cable, which terminates in a loose spiral, is inserted into a sleeve of sponge, which is firmly secured to it by sewing, the remainder being invested in a tube of thin rubber hermetically cemented upon it. The cable thus

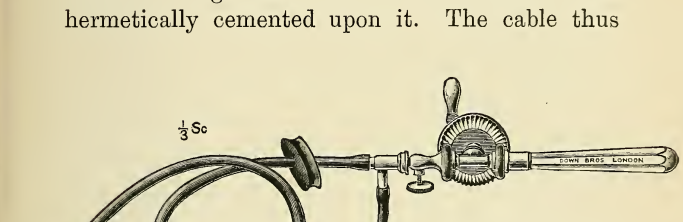

Fig. 34.—Turck's Gyromele.

armed is passed through a piece of rubber tube within which it is free to revolve, and is attached at its proximal extremity to a revolving drill handle. The gyromele, having been introduced into the stomach in the same manner as any ordinary stomach tube, can be caused to revolve by turning the drill handle, this operation being facilitated by a gag consisting of a vulcanite grooved block upon which the patient can close his teeth.

The gyromele may be used for the following purposes :—

To Remove Mucus from the Walls of the Stomach for Bacteriological Examination.—It is now a matter of common knowledge that in certain affections of the stomach we get colonies of micro-organisms actually growing upon the walls of the stomach, either in folds of the mucous membrane or in parts which have lost the power of muscular contractility. From such situations ordinary lavage always, and the needle-bath frequently, fails to remove them. We may wash out the stomach and find only the ordinary number of micro-organisms in the wash-water. In these cases the gyromele, used subsequently when the stomach is presumably clean, will often bring away mucus containing almost pure cultivations of various bacilli. For this purpose we shall use a gyromele with a sponge of small size which has been entirely withdrawn into a covering tube before introduction into the stomach. We shall thus avoid any accidental admixture with pharyngeal mucus. After the gyromele has reached the stomach it is protruded from the covering tube, and after rotation again withdrawn into it before it is removed from the patient. The mucus from the stomach will be in a practically pure condition, and unmixed with that from the pharynx and œsophagus.

As a Means of ascertaining the Position of the Stomach.

(*a*) By palpation. When the gyromele is introduced into the stomach and rotated it glides along the greater curvature of the stomach. This movement can be quite easily appreciated by the hand applied flat upon the abdomen, and in thin people we can often make out the position of the lower border of the stomach.

(*b*) By the X-rays. If we continue the introduction of the gyromele after the end has reached the pylorus it will double round and glide along the lesser curvature in such a manner that nearly the whole outline of the organ will be defined by the wire. An observation with the fluorescent screen will show us the shadow of the cable of the gyromele, and by marking this upon the surface of the abdomen an outline will be obtained, which will inform us as to the exact dimensions and position of the stomach. The subject has been already discussed on page 81.

To remove Adherent Mucus from the Stomach as a Method of Treatment in Cases of Chronic Gastritis.—This may often be done with advantage before treatment with the needle-douche, spray, or nebula in order to allow the medicated solution which we are about to use free access to the surface of the mucous membrane. Professor Turck himself in many such cases dips the sponge of the gyromele in a solution of soft soap and water and vigorously cleans up the whole of the interior of the stomach. A subsequent lavage will remove the soap and complete the cleansing process.

As a Massage Process upon the Walls of the Stomach.—Turck has demonstrated by experiments with animals that the risk of injuring the stomach wall in the absence of any lesion is extremely small, and that any slight injury will quickly heal. It was found to be almost impossible, with a rotating wire brush, to produce injuries which could be found on killing the animal a few hours afterwards.

As an Intragastric Electrode.—This will be further discussed in the chapter upon the application of electricity (see page 131).

The use of the gyromele is not difficult. The cable is passed in the same manner as the stomach tube, the patient sitting on the edge of the couch. The patient then lies down, and the handle of the drill is gently turned, the instrument at the same time being alternately advanced and withdrawn for two or three inches. When finally withdrawing the apparatus there is the same difficulty, when the larynx is reached, as in the case of the intragastric electrode, but not to the same degree. It is met in the same manner by making the patient swallow as the instrument is withdrawn.

CHAPTER VIII

THE APPLICATION OF ELECTRICITY TO THE STOMACH

The galvanic or continuous current—Induction coil current of high tension—Technique for treating muscular atony—Treatment of hyperchlorhydria—The triphase alternating current—Currents of high frequency and high potency—Direct application of the high-frequency current to the mucous membrane of the gastro-intestinal tract.

Recent work in the field of electrotherapeutics has added to our armamentarium the triphase alternating current and the currents of high frequency. The continuous current we still use in certain affections of the stomach. The ordinary small induction coil of the shops we may take as having been proved useless in gastric affections, and as having been superseded by the high-tension induction coil of at least 1,000 yards of wire.

The Galvanic or Continuous Current.—Although comparatively little used since the introduction of the more modern forms of electricity, we may with advantage master the technique of the administration, since sometimes it may be the only form available, and good and useful work may be done by its aid if properly applied. According to Einhorn,* who has used it extensively, when

* Max Einhorn, "Diseases of the Stomach," second edition, page 146. Ballière: London.

applied to the interior of the stomach by means of the intragastric electrode, it diminishes gastric secretion, and, to quote his own words, "is almost a sovereign means of combating severe and most obstinate neuralgias, no matter whether their origin is of a nervous nature or caused by a cicatrised ulcer of the stomach." I have myself in former times found it useful in the treatment of gastric myasthenia when used with a mechanical rheatome in the circuit, but now invariably use for this purpose the triphase alternating current.

For the efficient application of the continuous current to the interior of the stomach we shall require the following essential apparatus :—

A source of electricity capable of giving up to 50 *volts.*

This may consist of primary or secondary cells, or of a shunt circuit from a continuous current house supply.

As a matter of fact the safest and most convenient form of apparatus is a battery of primary cells fitted with galvanometer and double collector, as shown in the accompanying illustration.

A means of regulating the current before it reaches the patient.

In the case of cells this may either take the form of a dial collector to the studs of which they are severally connected, as in Fig. 35, or of an ohmic rheostat through which passes the whole current from the cells connected up in series. Among the most efficient rheostats are the Willms current controller * and the Jewell rheostat.† When the

* Made by the Chloride of Silver Dry Cell Company, Cincinnati.

† McKintosh Battery and Optical Company, Chicago.

current is derived from the house main of 100 or 200 volts, a ventilated shunt rheostat will have to be used in series with lamps as a safe precaution.

An efficient galvanometer for measuring the current.

Without a proper measuring apparatus our practice will be merely guesswork, as not only

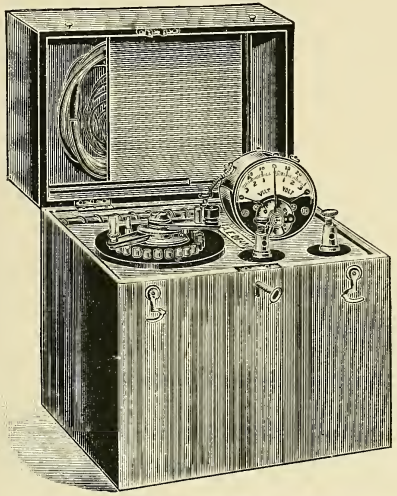

Fig. 35.—Continuous Current Battery fitted with Galvanometer and Dial Collector.

are the sensations of the patient a very imperfect guide to the dosage we are giving, but the actual current which is passing through the patient will vary according to the area of the electrodes, the degree of humidity of the same, and the variable resistance of the body, although we may be using the same E.M.F. or number of cells on each occasion.

The best galvanometer is, I think, D'Arsonval's form. A tolerably efficient substitute will, however, be found in the common magnetic type. A desirable range for the work will be from 0 to 150 M.A. This may or may not be differential, that is, having its zero in the middle of the scale. A better method is to use a more sensitive instrument of the same capacity, inserting it in the circuit at a spot before the pole changer. We thus obtain a fineness of reading equal to an instrument twice the size.

A mechanical rheatome.—This is a clockwork

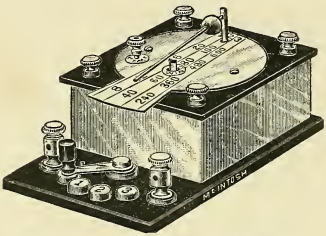

Fig. 36.—Mechanical Rheatome.

device for interrupting the current a given number of times a minute, and is indispensable when treating muscular paresis by the galvanic continuous current. The one figured above is on the principle of the metronome, and may be set to break the current automatically from 8 to 360 times a minute.

Electrodes.—We shall require the following electrodes:—

(*a*) An electrode for applying the current to the interior of the stomach. Until Einhorn, of New York, introduced his "deglutible" electrode, we

were only able to apply electricity directly to the interior of the stomachs of patients who were accustomed to the passage of the stomach tube, all the intragastric electrodes up to this date consisting of ordinary stomach tubes of rather large size containing a flexible wire. Einhorn's instrument was a great advance, as it could be swallowed with ease by patients who could not tolerate a tube. It consisted of a small hard rubber bulb carried on the end of a fine rubber tube of only 1 mm. in diameter. This bulb was perforated, allowing the fluid in the stomach to have access to

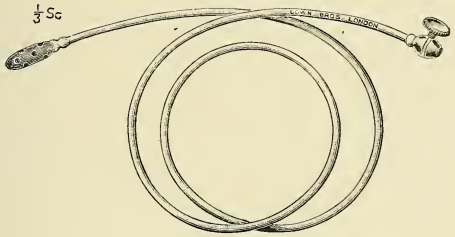

Fig. 37.—Reed's Intragastric Electrode.

a metal button in its interior which was attached to a fine wire passing through the tube. The disadvantages of this ingenious electrode were first that some patients could not swallow it, and the operator could not assist its passage on account of the flexibility of the wire, and secondly, there was always the danger from the slenderness of the rubber tube that the bulb might become detached and remain in the stomach of the patient. Ewald, of Berlin, improved this instrument by making the tube stiffer, and Boardman Reed, of Philadelphia, finally brought it to its present state of perfection

by altering the shape of the bulb, making it longer and narrower, and consequently easier to introduce and withdraw.

(*b*) Electrodes for application to the surface of the abdomen.

The best electrodes for the application of either the continuous or the induction coil currents to the surface of the body consist of flat pads of thick felt of varying area with a backing of vulcanised rubber projecting an inch or so all round. A metal plate lies between the pad and the rubber backing. The felt has been especially prepared to make it hydrophile and holds the water much better than flannel or sponge, and the rubber backing prevents the dress of the patient from becoming wet. These electrodes can be procured from most of the leading American makers, or in this country from A. E. Dean, 73, Hatton Garden.

In attempting to apply the continuous current to the interior of the rectum or to any other mucous membrane by means of a naked metal electrode, we are met with the difficulty that electrolytic action takes place at the negative pole. We are thus liable to cause severe burns. Various devices have been employed to avoid this, notably the introduction of water into the rectum. This is messy and almost impracticable in one's consulting room. But we can secure all the advantages of this method by surrounding our electrode with a bag of thin animal membrane (a condom), introducing this collapsed into the rectum and then pumping it full of water. We shall thus have wet membrane in contact with mucous membrane, and no harm can possibly ensue. An additional advantage will be that the

expanded cylindrical electrode will offer a very large active surface, and the electricity will be spread over a comparatively large area.

The idea of surrounding the active electrode with an animal membrane is, I think, due to Pennington, of New York, who designed a colon electrode on these lines. This consisted of a thick rubber tube terminating in a perforated carbon tip, and was about 15 inches long. For use within the rectum I have had constructed from my design an electrode which, sharing with Pennington's the covering of animal membrane, is of very different construction. My electrode consists of four essential parts, separate and detachable.

Part 1. A tap carrying on one end a female screw, and terminating at the other in half an inch of corrugated pipe for the attachment of 2 inches of rubber tubing.

Part 2. A metal cone, to one side of which is attached a wire spiral terminating in a knob, and on the other a male screw for reception to the corresponding female screw on Part 1.

Part 3. The terminal 4 inches of a red rubber stomach tube perforated with several extra holes. This is slipped over the wire spiral on Part 2, and pushed well home on to the cone.

Part 4. The membranous envelope which is put over Part 3 and secured either by tying with silk or by a small indiarubber ring.

An illustration of this electrode will be found in the author's work on Polyphase Currents.*

Rheophores.—Among the best rheophores or

* "Polyphase Currents in Electrotherapy. With special reference to the treatment of Neurasthenia, Atomic Dilatation of the Stomach, and Constipation." London: Glaisher, 1903.

conducting cords are those manufactured by the McKintosh Battery and Optical Company of Chicago. They are composed of strands of copper wire enclosed in tinsel and closely woven into an insulated cable. An equivalent of British manufacture has been introduced under the name of arc-lamp flex. The wires in the McKintosh rheophore are fastened to the tips by a new device which makes a perfect connection. It is known as the McKintosh adjustable cord tip, and its advantages will be appreciated by all those who have had much experience of the flimsy conducting cords of German manufacture which are usually supplied with batteries purchased in England. The McKintosh tip can be securely

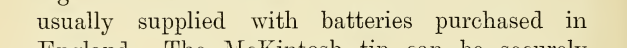

Fig. 38.– McKintosh Rheophore Tips.

fastened by any one to the cord in the following manner: To repair a cord unscrew the tube from the tip, draw the cord through, cut away the broken end of the cord, knot the wires and again screw the tube into the tip. This clamps the wires as seen in the left-hand figure, and makes a good connection.

Technique of Applying the Galvanic or Continuous Current to the Stomach.

(*a*) By external electrodes.

Although not an intragastric method, it is essential that we should commence by acquiring familiarity with this procedure, as we shall learn the correct manipulation of the apparatus and cannot by any possibility do any serious damage to the patient. It is not too much to say that no

one should attempt to apply any form of electricity to the interior of the stomach before he has acquired the necessary dexterity in the handling of the current by external applications. Moreover, although the simplest method of applying electricity, many cases of gastric neurasthenia are undoubtedly benefited by the application of the continuous current to the epigastric region, and, as I have said before, we may use it with advantage in cases where the patient cannot tolerate the passage of any instrument into the stomach, or where the continuous-current battery is the only source of electricity which we have at our disposal.

A couple of flat electrodes, of about 16 square inches in area, are selected and put to soak in a basin of warm water, to which has been added a little bicarbonate of soda as suggested by Monnell of New York. Soda is far superior to the salt or vinegar in common use, as it increases in a more marked degree the conductivity of the electrode and does not corrode the metal part of it. The two connecting cords are attached to the binding screws of the battery, and the handle of the collector or of the rheostat turned back to the starting post. The two electrodes are now taken out of the basin of water and just as much water expressed as will prevent dripping when they are held up. The rubber margins round the edge of the pad and the back of the electrode are wiped dry, and the connecting cords are attached to the binding screws of the electrodes (or placed in the sockets in a Kidder electrode).

The patient lying upon a couch, one of these electrodes is placed either on the nape of the neck

or upon the dorsal region with a folded towel under it, and is retained in position by his weight. The other electrode is now applied to the epigastric region, covered with a folded towel and retained in position by the hand of the patient, or better still by a bag of shot. The handle of the collector or of the rheostat is now very gradually turned until the current, as shown by the galvanometer needle, reaches the dose which it is required to give. At least a minute should be occupied in reaching this maximum. The current is then allowed to pass for the allotted time and then just as gradually turned off. The electrodes are then to be removed. In order that we may avoid giving shocks to the patient these events must follow precisely in this sequence, the electrodes being invariably placed in position before the current is turned on, and not removed until it has been turned off again. The exact dose, the duration and frequency of the applications must of course be determined by the nature of the complaint, the condition of the patient, and the effects produced. In an ordinary case of gastric neurasthenia we may commence by giving five milliamperes for five minutes, and gradually increase both the dose and the duration of the sitting until we arrive at a maximum of fifteen milliamperes for twenty minutes. To obtain good results in a case of this nature, we should give a daily treatment for six successive days a week for four or five weeks, and then two or three times a week for another couple of months. We must remember that we are treating a chronic condition and must use chronic treatment, and that we cannot expect any immediate or magical improve-

ment, as we can only very gradually restore tone to exhausted nerve centres. For sedative effects we shall use the positive pole, and the negative one when we require to stimulate.

When applying the continuous current to the skin of the abdomen we must be on our guard against superficial burns. The healthy unbroken skin offers a considerable resistance to the passage of electricity. But the smallest breach of surface, such as a scratch or pimple or an inflamed hair follicle, will allow such a concentration upon this point of least resistance, that a tiny eschar will quickly form, and an ulcer will follow which often takes a long time to heal. Such a burn will show itself in the first instance as a little white spot. We should always examine the skin whenever the patient complains of pain, and if we find any such small burns apply a piece of rubber adhesive plaster before continuing the application.

The undoubtedly beneficial effect of the continuous current applied by external electrodes is probably due to sedation or stimulation of the sympathetic ganglia which control the innervation of the stomach, and not to any direct action upon the organ itself.

(*b*) By one external electrode and one within the stomach.

For this method of treatment we shall require a flat electrode of about 20 square inches in area and the intragastric electrode.

The first step is to see that everything is in order—the electrodes in a basin of warm water, the connecting cords attached to the binding posts of the battery, and the handle of the collector or rheostat in position at the starting post.

The next step is to give the patient, whose stomach should be empty, a large tumbler of water to drink to provide the medium for carrying the electricity from the intragastric electrode to the stomach wall. We may add with advantage a half teaspoonful of bicarbonate of soda to the tumbler of water. The next thing to do is to take the electrodes from the basin, prepare the flat electrode as in the preceding section, and attach it to the rheophore connected with the positive pole of the battery. Dry the intragastric electrode and lubricate it with glycerine jelly, but do not attach it to its connecting cord until it has been passed into the stomach.

As intragastric electrization is best applied in the recumbent position, whilst *per contra* the electrode is passed with greatest facility when the patient is sitting or standing, the most convenient routine is to sit the patient for the latter purpose upon the edge of the couch upon which he will afterwards recline. As soon as the electrode has been passed he can put up his legs and lie down without any trouble and without shifting the instrument. The dress should have been already arranged so that the abdomen is accessible without having to undo any garments after he has assumed the horizontal position. These little points, although trivial in themselves, make all the difference between doing the work with neatness and dispatch and in a bungling manner.

The actual passage of the intragastric electrode is performed in exactly the same manner as the ordinary stomach tube (*vide* page 12). It will usually pass much easier, for as soon as it has passed the larynx it will in most cases be grasped

by the muscular fibres of the œsophagus, and be actually carried down into the stomach without any assistance from the operator. We know when the bulb of the electrode reaches the greater curvature of the stomach as its motion will then be arrested. It is, however, always advisable to have marks upon the stem of the instrument at 15, 20, and 25 inches from the end in order that we may know where we are. After the electrode has reached the stomach, the patient holds it in position with his left hand, puts up his legs, and lies down on the couch. The abdominal electrode is now placed in position upon the epigastric region, the connecting cord is attached to the intragastric electrode, and the current is gradually turned on and the prescribed application given.

At the end of the treatment the steps are reversed. The abdominal electrode is first removed and placed upon the table alongside the battery. The connecting cord is detached from the intragastric electrode, the patient puts his feet on to the floor, and sits on the edge of the couch. The electrode is then gently removed and placed in a tray. As pointed out by Einhorn, when on its withdrawal the bulb of the electrode reaches the introitus œsophagi, a resistance will be felt as the instrument hitches against the back of the larynx. Do not use any force, but simply direct the patient to swallow. Watch the larynx, and the moment you see it rising up pull gently upon the electrode, and you will find that it comes out quite easily. Einhorn uses a sponge electrode labile over the gastric region for three minutes, and then for one minute over the back at the left side of the seventh dorsal vertebra, again for the

same period upon the gastric region, finishing up by one minute's application just below the ensiform cartilage. He increases the current during the first minute from 15 to 20 milliamperes and diminishes it during the last minute.

In my own practice I prefer to use a larger abdominal electrode, and allow it to remain stabile for one-third of the total time of the treatment upon the epigastric region, one-third of the time behind upon the dorsal region as recommended by him, and finish with it for the remaining third in front. In my opinion the current strength at first should not exceed 5 milliamperes, and the total duration of the treatment six minutes. Both are gradually increased until 20 milliamperes are eventually given for 12 minutes.

After the operation the electrode should be disinfected in the manner advised for stomach tubes on page 13, and hung up to dry in a dust-proof cupboard. It is always best to keep the intragastric electrode hanging up when not in use, as the wire will thus be kept free from kinks.

Turck's gyromele forms a very efficient intragastric electrode and sometimes passes easier than Boardman Reed's apparatus. It requires, however, more careful cleansing after the operation on account of its construction.

(*c*) With one electrode in the stomach and one in the rectum.

With this arrangement of electrodes we can secure a very powerful action, and practically confine the current to the gastro-intestinal tract.

The procedure is similar to that just described, with the exception that the external electrode is replaced by one in the rectum. To avoid the

trouble of the periodical reversals of current necessary to avoid injury to the rectal mucous membrane when a metal electrode is used, it will be convenient to make use of the membrane covered rectal electrode described on page 133. The intragastric electrode having been passed, the patient lies down on his side in the Sims' position. The rectal electrode, which has been well soaped, is now introduced and distended with water. The connecting cords are attached to their respective electrodes and the current gradually turned on. When the application is finished the water is allowed to escape from the rectal electrode into a vessel as it is withdrawn. The patient then sits up, and the intragastric electrode is removed. The membranous envelope of the rectal electrode after use should be well washed and inflated with air, its mouth secured by a twist and hung up to dry. It can thus with care be used for the same patient at least a dozen times.

The Treatment of Gastric Myasthenia by the continuous galvanic Current.—When this current is the only one at our disposal we can make shift with it to treat cases of muscular weakness of the stomach walls by utilizing the contractions which occur at the make and break of the circuit. We do this by interposing in the circuit a mechanical circuit breaker such as the rheatome figured on page 130. I do not think that muscular contractions can be produced in the walls of the stomach by the continuous current when used percutaneously (*i.e.*, by external electrodes), we must therefore use the intragastric electrode with the indifferent pole either upon the abdomen or in the rectum. The current strength should be just

sufficient to set up contractions in the abdominal muscles, and the rate of break should be from 90 to 120 per minute.

Induction Coil Current of High Tension.—This must not be confounded with the currents of high frequency and high potential produced by the D'Arsonval apparatus. We call the current from an induction coil a current of high tension when it will glow a Geissler tube, and this glowing of a vacuum tube offers us a ready method of testing whether any given induction coil is adequate to produce those currents of high tension so valuable for their sedative effects. We must have at least 1,000 yards of fine wire in the secondary winding of an induction coil to produce a current of this character.

The quality of the current produced by the secondary winding of an induction coil will depend upon the number of turns of wire. The oftener you can cut the magnetic lines of force which surround the central iron core of the induction coil, or, in other words, the greater number of turns of wire in the secondary, the greater will be the voltage of the current induced in it. At the same time the amperage will be proportionately reduced owing to the resistance offered by the length of wire and by the self induction. It is obvious therefore that currents induced in secondary coils of different length and thickness of wire will vary in voltage and amperage, and consequently in therapeutic effect. A modern induction coil has the secondary wound with several lengths of wire of different thicknesses, connected in series, but tapped in such a manner that they may be used singly or in combination. The operator is thereby

enabled to select the coil which from amperage and voltage is judged to be most suitable for the treatment of the case in hand. As a type of the best form of modern induction coil we may take the Kidder coil.*

This magnificent instrument contains in its secondary coil the following windings:—1,000

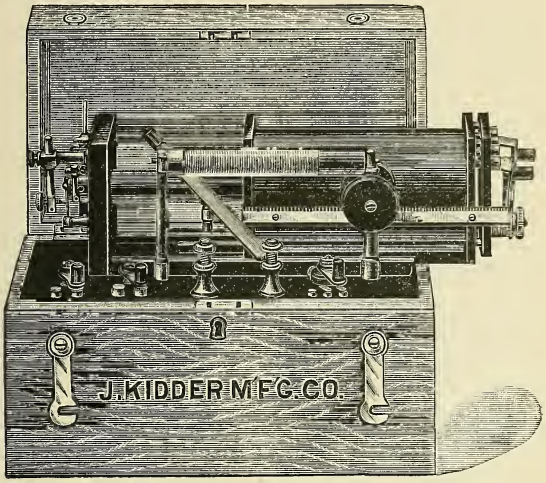

Fig. 39.—The Kidder Induction Coil. Sledge Pattern.

yards of No. 36 wire, 500 yards of No. 36 wire, 500 yards of No. 32 wire, 300 yards of No. 32 wire, 154 yards of No. 21 wire, and 84 yards of No. 21 wire. In all 2,538 yards, or nearly a mile and a half. By means of a double switch at one end of the coil the operator can select any of these windings or use two or more in combination, thus

* Kidder Manufacturing Company, 280, Broadway, New York.

practically giving him a choice of twenty-one distinct coils. With the smaller lengths of thicker wire, currents of lower intensity but larger quantity are obtained, useful in the treatment of paresis; with the 1,000 or 1,500 yards of fine wire the current obtained is of high tension, capable of producing the very remarkable effect of reducing the

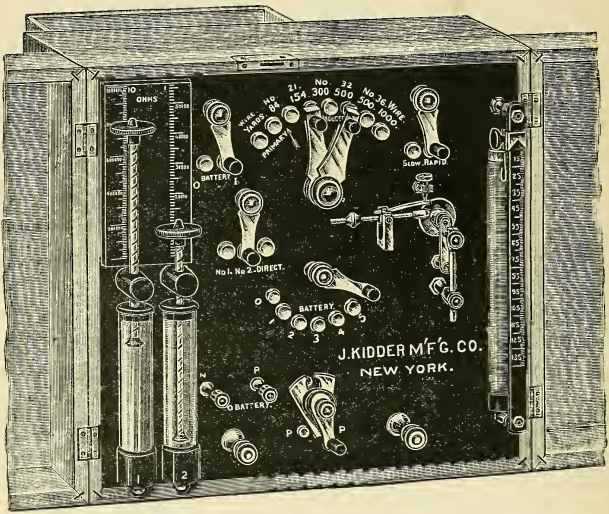

Fig. 40.—Kidder Compound Induction Coil. Monell's Vertical pattern.

secretion of HCl in cases of hyperchlorhydria, as was pointed out by Boardman Reed.*

The Kidder coil further contains a rheostat in the primary circuit for regulating the E.M.F., a

* Boardman Reed, "Direct Electrization of the Stomach, especially by high-tension Faradic Currents." *Philadelphia Medical Journal*, February 5, 1900.

rapid and a slow interrupter, a movable magnetic field by which the speed of the rapid interrupter can be regulated, and a rack and pinion which moves the secondary coil over the primary.

Dr. Monell, of New York, has further modified the Kidder coil in several particulars. The most important of these is the substitution of rheostats in the secondary circuit to regulate the current instead of using the sledge device. These rheostats shown at the left-hand corner of the illustration, and marked 1 and 2 respectively, are filled with a liquid of known resistance. We can therefore record the dose which we are giving the patient by stating the length and thickness of wire used, the number of cells in the primary circuit, and the amount of resistance placed in the primary and secondary circuits respectively. This apparatus can either be worked by the six dry cells contained within it and connected to the studs of the switch shown at the centre of the switchboard, or by outside cells which in this case are connected to posts shown at the immediate right of the rheostats, and marked "battery."

Technique for treating Gastric Myasthenia or Muscular Atony of the Stomach by the Induction Coil.—As it is our object to restore tone to the muscular walls of the stomach we must bear in mind the fundamental fact that we cannot strengthen a muscle by provoking a tetanic contraction of its fibres. If we throw a muscle into tonic contraction by the application of the induction coil current we shall only exhaust it. If we wish to strengthen it we must allow periods of repose to elapse between the contractions. We can do this to a certain extent by

continually removing and replacing the electrode or applying the current by a series of stroking movements, but far more efficiently by mechanical means. We may include in the circuit the rheatome figured on page 130, or, if we are using the Kidder coil, we make use of the slow interrupter which we set to give from 100 to 200 interruptions a minute. Experience also teaches us that the best results are obtained with a coil of comparatively small internal resistance, as we require amperage to do the work of throwing the muscle into efficient contraction. We therefore select the 800 yards of No. 32 wire. Having arranged our apparatus we pass the intragastric electrode in the manner already described and place our patient upon the couch. We now connect the intragastric electrode with one pole of the battery, it does not much matter which, and to the other we connect a flat electrode of about 20 square inches in area which we place upon the abdomen, holding it in position with the shot bag. Before setting the coil in action we rack out the secondary as far as it will go, in order that when we start the coil no current may reach the patient. We now start the coil into action, adjusting the E.M.F. by means of the rheostat in the primary circuit, into such a correlation with the interrupter that we may get the smallest possible spark gap. We now rack in the secondary coil over the primary until the abdominal muscles are thrown into visible contractions. Continue the application in this manner for five minutes, and then move the external electrode from its position in the epigastric region to a position over the left lower ribs in the mid-axillary line. To hold it in position here a

folded towel may be placed upon it and the patient may turn slightly over to his left side. After another five minutes' application in this position the patient will have had enough, and the treatment may be terminated.

Cases of myasthenia of the first and second degree will usually be cured by this method of applying electricity in a course of five or six weeks, the treatments being given daily for the first month. The third degree of myasthenia, where there is retention of food residues, is usually not much improved, requiring, as it does, for its successful treatment the triphase alternating current, which, as a matter of fact, produces by far the best results of any form of electricity in all stages of muscular weakness of the stomach. The high-tension induction coil current should therefore only be used when the more modern triphase current is not available.

To relieve Hyperchlorhydria by diminishing the Secretion of HCl.—It is for this purpose that the high-tension induction coil current should be chiefly used in the treatment of affections of the stomach, as it is in this direction that it finds its greatest sphere of usefulness.

As we have already indicated, we owe this valuable discovery to Dr. Boardman Reed, from whose paper we quote the following:—

"My experience teaches me that such a coil, with a long fine wire and rapid interruptions applied with one pole in the stomach and the other in the form of a large flat sponge, felt or clay electrode over the epigastrium, will almost uniformly, and rather speedily as a rule, lessen the percentage of hydrochloric acid in the gastric

juice, whether it was previously normal or in excess. Having early learned of its markedly depressing effect upon the glands, I have never employed the high tention coil in a case of deficient gastric secretion, but have learned to rely upon it as my sheet anchor in stubborn cases of the opposite class in which there is excessive secretion."

To apply the current in this manner with a Kidder coil, rack out the secondary coil as far as it will go away from the primary. Switch in the whole 2,358 yards of wire, switch in the rapid interrupter, adjust the movable magnetic field and the screw of the contact breaker in such a manner that with the rheostat turning on about half the available E.M.F. from the cells, the smallest possible spark gap is obtained. The electrodes are adjusted in the same manner described in the previous section and the patient in lying upon his back upon the couch. Rack in the secondary coil until the current is just perceptible to the patient. Allow this current to pass for ten minutes. Then gradually turn off the current by racking out the secondary again, taking at least three minutes to pass from the maximum which you have been giving to zero. A treatment should be given every day for fourteen days, then an analysis of the gastric juice an hour after an Ewald test breakfast should be made. If there is any reduction in the amount of HCl the treatment may be given on alternate days for another equal period, and if another analysis prove equally satisfactory, twice a week for another month. It cannot be too strongly impressed upon the reader that the current from the ordinary small Faradic

coil of commerce will *not* give a sedative current, but will do positive harm in these cases. Such a coil has probably only 50 yards of wire in its secondary and a common rough contact breaker incapable of giving the fine, smooth, rapid interruptions which are necessary. The test is the power of the coil to glow and stratify a Geissler tube. If it will do so it is suitable for this treatment. If it fails to do so, it is inadequate and should be rejected.

The high-tension induction coil may be used: (*a*) With the intragastric electrode in the stomach and an external flat electrode applied to the epigastric region. (*b*) With the intragastric electrode in the stomach and an electrode in the rectum. As when using the induction coil current there is no chemical action, we may make use of an uncovered metal electrode in the rectum with impunity. Nevertheless, there is the advantage in using the water-distended apparatus described that it offers a larger surface and allows the electricity to come in contact with a greater area of the rectal mucous membrane. In fact, we secure all the advantage of filling the rectum with water without the mess and inconveniences necessarily attending this procedure.

The Triphase Alternating Current.—Although well known among electricians and largely used for industrial purposes, it was not until about seven years ago that Guimbail, of Paris and Monaco, first used the polyphase currents therapeutically. They are now largely used in France, and triphase generators are to be found in Rivière's and other large establishments. I have reason to believe that I can claim to have been the first to make use of them in this country, and to have made

certain modifications in their construction which fit them more particularly for medical use.

As far as we know at present the triphase alternating current appears to be *par excellence* the current to use for the purpose of restoring tone to the muscular substance of the gastro-intestinal tract, and has the great advantage that it is not necessary in most cases to introduce electrodes into the stomach. When applied percutaneously the triphase alternating current produces manifest contractions in the stomach and intestines, and considerably shortens the time that food remains in the stomach.

It is a task of great difficulty to describe a triphase current in a few words and in terms which shall be intelligible to any but electricians in the space at my disposal in this work; I shall therefore not attempt to do so, but refer the reader to my little book on Polyphase Currents already mentioned, which deals sufficiently fully with the purely technical and electrical part of the subject.

Fig. 41 shows a triphase generator which was especially designed for medical work by the author, with the able assistance of Mr. A. E. Dean, the manufacturer. The generator proper is shown above, and below it a triple transformer by which the current from each phase can be regulated simultaneously and to the same extent. The secondary coils, which travel over the primary ones, are connected together and moved *en masse* by means of a long screw actuated by a handle seen at the right hand of the cut. A special feature of the apparatus is a triple plug connection instead of binding screws on the base board of the transformer. This little point adds much to the facility

with which the necessary connections can be made.

Technique for the application of the Triphase Current in Atony of the Stomach.—It is important that the electrodes used in the application should each be of the same area. This is obvious from the

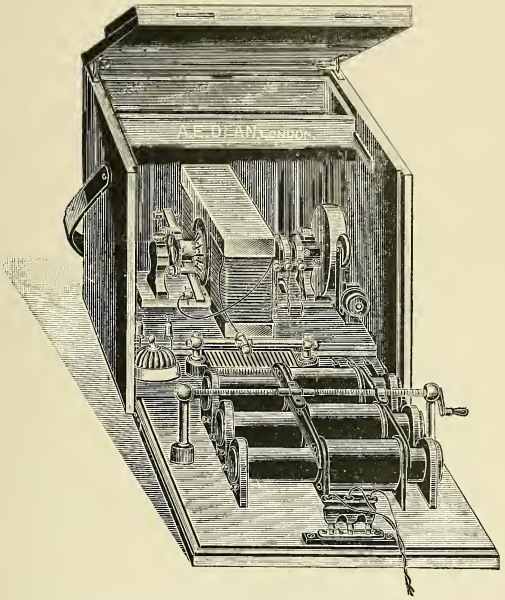

Fig. 41.—The Herschell-Dean Triphase Apparatus.

fact that the polarity of each changes in rotation. Convenient sizes are 2 by 6 inches for the ones to be used at the back, and 3 by 4 inches for the one to be placed upon the abdomen. These are well wetted and placed, the formed upon the dorsal region, one on each side of the vertebræ, and the

latter upon the epigastric region, the patient lying upon the couch. The electrodes are attached to the rheophore, but the triple plug is not yet to be attached to the machine. The accumulators are now connected up by wires to the binding posts of the generating group and the machine started to ascertain that it is in running order. The transformer is at zero. The machine is now stopped and the triple plug placed in the socket. The machine is now started and arranged that it will revolve at the number of revolutions required to give the requisite number of muscular contractions a minute. The transformer handle is now gradually turned until by the amplitude of the muscular contractions reached, and the sensations of the patient, it is evident that the point of tolerance has been reached. After the application has been given for the length of time determined upon, the current is gradually turned off by means of the transformer. When the current has returned to zero the electrodes may be removed. The most important point to bear in mind is that on no account must the machine be stopped by switching off the current from the accumulators. If this is done a back E.M.F. will be produced which will give an unpleasant shock to the patient.

Currents of High Frequency and High Potency.—This modality of electrical energy which appears to have been first used by Morton, and elaborated by D'Arsonval, is now so well known and familiar to all of us that it needs no description from me. Among the different arrangements of apparatus for producing the high-frequency currents we have practically to choose between three forms.

1. The Gaiffe model. This comprises a con-

denser consisting of flat plates of glass and tin arranged alternately and immersed in a tank of oil, the Contremoulins-Gaiffe rotary brake and the *bobine double* of D'Arsonval.

2. The German pattern as constructed by Kohl of Chemnitz. The condenser here consists of two

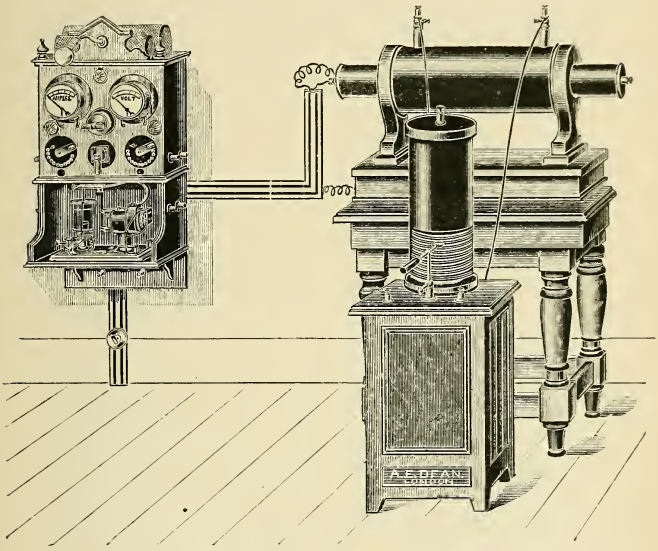

FIG. 42.—The Dean Model High-Frequency Group.

leyden jars, there is a small solenoid and a small horizontal resonator, and either a jet brake or a film brake is used.

3. The English model as represented by Dean. This is apparently the simplest and least liable to get out of order, and consists of an upright switch board carrying galvanometer, ammeter, compound

switch, and ventilating rheostats to the motor and coil circuit. The brake used is of the dipper form, and this has been purposely selected as it is always certain to work when required and can be much easier cleaned than the revolving jet brake. The resonator is of the upright Oudin pattern.

For the scientific use of the high-frequency currents a proper galvanometer is a *sine quâ non*. The only kind with which it has been found possible to measure these currents depends for its action upon the expansion of a wire which becomes heated by the passage of the electricity.

Those who desire instruction in the manipulation of high-frequency apparatus will find the subject admirably elucidated in the recently published work by Chisholm Williams.* I shall confine myself to describing the technique of the special methods by which the high-frequency current may be applied to the stomach. These electric currents may be applied in affections of the stomach in three ways.

By external electrodes; by an electrode applied to the mucous membrane at the two ends of the alimentary canal; by one electrode in the mouth or rectum, and one upon the abdomen.

By external electrodes.

We have convincing proof that on placing a dry metallic plate or a moistened sponge or felt electrode upon the surface of the body the whole organism becomes permeated with the high-frequency electricity. The resistance of the skin, although very great, is so much less than that of the air, a current of 50,000 volts being

* "High Frequency Currents in the Treatment of some Diseases." Rebman, 1903.

necessary to enable the electric spark to leap across an air gap of one inch, that we may reasonably assume it will not offer much obstruction to the current from a coil capable of giving a ten-inch spark, especially when the potential of this has been again raised by the high-frequency apparatus.

In a recent article in the *Lancet* it was claimed that the application of currents of high frequency by external electrodes to the surface of the abdomen would cure cases of atonic dilatation of the stomach. It is the fate of all new methods of treatment to have claims made for them which will not stand the test of scientific investigation, and thus to suffer for a time unmerited discredit from the unwise enthusiasm of their supporters. It were wise, therefore, to examine critically such a claim as that advanced by the article in question.

In the first place, we should not *à priori* expect the high-frequency current to influence the motility of the stomach. It is one of its characteristics that it has no effect upon motor or sensory nerves. If it will contract muscular tissue when applied by a stabile electrode to the surface of the body, then all the classical writings upon the subject are unreliable. As a matter of fact, the high-frequency current WILL cause muscular contraction, but only when the apparatus is out of order or badly adjusted, or there is a spark gap in the circuit. In support of my contention, I quote the following remarks by D'Arsonval himself from the *Archives d'electricite medicale*, January 15, 1902, pages 46 and 47.

"As regards muscular contractions, it is absolutely necessary to avoid them if you wish to study the real action of high-frequency currents. If you get muscular contractions, it proves either that the current is too strong for the frequency employed, or is badly adjusted in one of the following particulars:—1. The distance between the balls of the detonator is wrong. 2. The balls are irregular or badly polished. 3. The spark is arced. 4. There may be bad contact or some small interruption in the circuit. 5. The armatures of the condenser may be badly applied upon the dielectric. 6. The capacity may be too great; or 7. The self induction may be too great. After some trials one is always able to suppress all sensation and all muscular contraction. Always when I speak of high frequency it is well understood that I am alluding to pure high frequency exciting neither the nerves nor muscles."

It is obvious, therefore, that a current which will contract up the stomach may be one of a very useful character, but it is not the true high frequency as understood by D'Arsonval.

An examination of the cases upon which the article is based appears to my mind to show that in all probability they were not dilation of the stomach at all. That is to say, that the stomachs were able to empty themselves in the normal time and there was no retention of food residues. The facts relied on by the writers indicating dilation of the stomach were apparent enlargement of the stomach on percussion and the presence of splashing on palpation, both known to be fallacious as signs of ectasia. The cases

were, most probably, instances of general neurasthenia, accompanied as is often the case by atony of the first degree. The stomach, while able to empty itself before the next meal, had lost, to a certain extent, its power of contractility, and would sag down under the weight of food introduced and allow splashing to take place.

But whilst, as we might expect, the currents of high frequency may be of little use in the

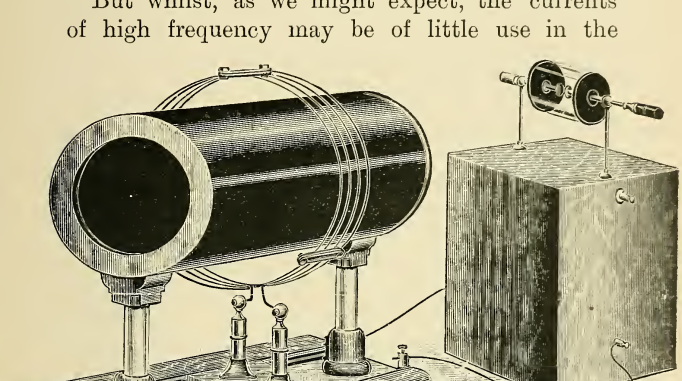

Fig. 43.—The D'Arsonval Bobine Double.

treatment of gastric myasthenia, yet there is in all probability an immense field open to them in the treatment of ulceration of the stomach and cases of malignant disease which are unsuitable for operation, and the various anomalies of accretion such as primary hyperchlorhydria.*

* *Vide* the author's paper "On the treatment of primary hyperchlorhydria by the direct application of currents of high frequency to the mucous membrane of the alimentary tract." *International Medical Magazine*, Philadelphia, 1903.

From what we know of the action of these currents upon ulcerations upon the surface of the body, there is no valid reason why equally good results should not follow their application to the interior of the stomach.

The methods which I adopt for the direct application of the currents of high intensity and frequency to the interior of the stomach are:—

(*a*) By the applications of electrodes to the mucous membrane at the two extremities of the alimentary canal. That is, in the mouth and in the rectum.

(*b*) By the application of one electrode within the mouth and one to the epigastric region.

(*c*) By the application of an electrode to the epigastric region and one within the rectum.

In using these bipolar applications of the high-frequency current, I take the electricity from the two ends of the *bobine double* of D'Arsonval. (Fig. 43.) In this apparatus the intensity of the high-frequency current is raised by induction, and not by resonance as in the Oudin resonator. The effleuves produced by it are soft and well borne by the patient.

As the abdominal electrode I most frequently use a flat glass bottle with rounded edges which has been filled with a saturated solution of salt and water, and through the cork of which a wire projects into the interior. This may be applied directly to the skin or may be enveloped in a tightly-fitting bag of well-wetted lint.

By this method we secure the passage of the high-frequency current over the surface of the mucous membrane of the stomach. The current will, of necessity, follow the path of least re-

sistance, and as this is the moist surface of the alimentary tract, the current must pass along that. This fact can be readily demonstrated by the following experiment. Place the patient upon the couch, place a moistened electrode upon the abdomen and another upon the nape of the neck. Connect the patient in derivation with the spires of the small solenoid, so that a current of 250 milliamperes will be registered as passing through the body. Now replace the electrode which has been at the back of the neck by the author's tongue electrode upon the tongue, leaving the abdominal electrode *in situ*. At once the galvanometer will register at least 500 ma. Replace the abdominal electrode by a bulb in the rectum, and we shall have from 600 to 700 milliamperes passing through the body. We thus prove that the resistance of the alimentary canal is much less than that offered by the skin, and, according to the laws of electricity, the current must pass either in or out the surface of the wet mucosa. With one electrode upon the tongue and the other upon the abdomen over the stomach region, we may logically infer that the current arriving at the stomach along the mucous surface penetrates the tissues and leaves the body by means of the abdominal electrode.

For this method of application we insert into the rectum a metal bulb. When using the high frequency current from the small solenoid it may be conveniently shaped as in Fig. 44. This form can be used with the patient lying on his back. The quantity of current in this case is regulated by taking it in shunt from a smaller or greater number of spires of the small solenoid.

But when using the current from the resonator we require some method of regulating the amount of electricity more under control, and we may

Fig. 44. – Author's Electrode for applying the High-Frequency Current to the Rectum.

make use of the regulating handle of Dr. Bisserie or the one figured below. In this case we preferably use a bulb with a straight stem.

Fig. 45.—Author's Regulating Handle with Electrode for the application of the Resonator Current to the interior of the Rectum.

During this application the patient would preferably be placed in the Sims' position upon

Fig. 46.—Author's Tongue Electrode.

his side. The operator sitting at the side of the couch will hold the handle of the electrode.

The electrode for placing upon the tongue is a Turck's tongue depressor modified by the addition of a metal plate upon its under surface.

It is needless to remark that in this method of applying the high-frequency current extreme care must be taken to graduate the current to the effect produced. The temperature and pulse rate should be taken before and after the seance, and the application stopped as soon as the signs of saturation are observed. It should also be obvious that the current must be applied by the practitioner himself, and not delegated to a nurse or unqualified medical electrician. An unfortunate fact about the currents of high frequency is the apparent facility with which the current can be given to the patient. At first sight it appears that you have nothing to do except to place the patient upon a condensing couch, start the machine, and let him remain there for the prescribed number of minutes. This is much to be deplored, and must infallibly bring discredit upon this most useful modality of electricity. Unfortunately, Town Councils of watering places and quack institutions for physical treatment are purchasing machines of high frequency and putting nurses to work them after one or two lessons. No good results can possibly be obtained in this way except by accident, as it is not the machine but "the man behind the gun" who produces the results. In the high frequency we have a tool of great power (remember we are handling thousands of volts and can pass 500 milliamperes with ease through the patient), capable of producing certain specific effects upon the metabolism of the body, and it is surely a

criminal act to allow it to be administered by any one except an expert. The nurse is absolutely incapable of judging the effect of the treatment which she is giving and of deciding upon the current strength, duration of sitting, and frequency of application.

In cases where we wish to confine the electricity as much as possible to the stomach or œsophagus, we shall apply a moistened pad electrode to the epigastrium, using for the other pole the tongue electrode.

Similarly where we wish to act chiefly upon the intestine, we shall use the moistened pad upon the abdomen and the rectal electrode.

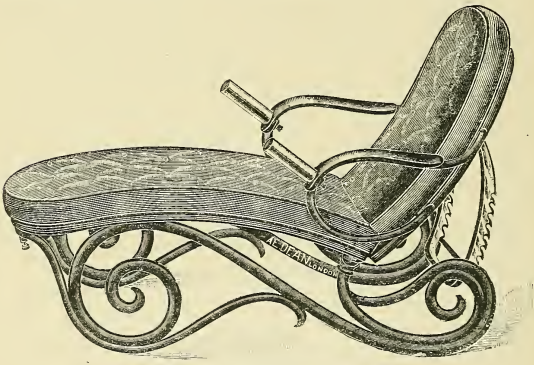

Fig. 47.—Condensation Couch.

In all cases where we are treating the patient with high frequency it is important, whilst paying special attention to the stomach, not to neglect general treatment. We may therefore alternate the local application with anti-condensation upon the couch figured above, which is connected in derivation to the two ends of the small solenoid.

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